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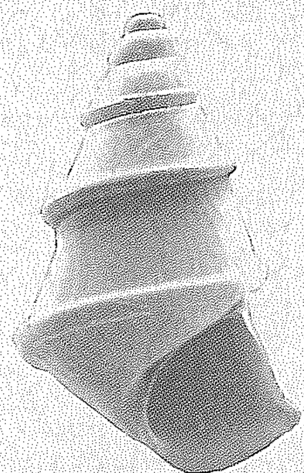
FRESHWATER MOLLUSKS OF THE UPPER KLAMATH DRAINAGE, OREGON



Pyrgulopsis archimedis Berry, 1947

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FRESHWATER MOLLUSKS OF THE UPPER KLAMATH DRAINAGE, OREGON

1998 yearly report

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April 2, 1998

Upper Klamath Lake is one of the few surviving Pliocene lakes and the only one with normal alkalinity and a large relict fauna. It is likely the best remaining window on environments prevalent in the interior West 2-17 million years ago.

-Frest & Johannes, 1995

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FRESHWATER MOLLUSKS OF THE UPPER KLAMATH DRAINAGE, OREGON

BACKGROUND

The Upper Klamath drainage has been a focus of malacological interest since the 1830s. This preoccupation is reflected in the fact that several mollusk species have their type localities there (*Lanx klamathensis*, *Vorticifex effusus dalli*, *Vorticifex klamathensis klamathensis*, *Vorticifex klamathensis sinitsini*, *Pyrgulopsis archimedis*). One federal candidate species, *Pisidium ultramontanum*, was previously known from the region. One other federal candidate, *Anodonta californiensis*, was discovered live in this region in 1993. Some 14 Upper Klamath drainage species were included in the Clinton forest plan (FEMAT, 1993) report (Mollusc Species of Special Concern Within the Range of the Northern Spotted Owl, Frest & Johannes, 1991b, 1993b; see also Final Supplemental Environmental Impact Statement (FSEIS, 1994a); FSEIS Appendix J2 (FSEIS, 1994b), SEIS, 1993, 1994; and ROD, 1994); USFWS 1992a; as well as an additional 9 taxa from the middle Klamath drainage (Table 1). Essentially the same list of species was part of a report for the Interior Columbia Basin Ecosystem Management Project (Interior Columbia Basin Mollusk Species of Special Concern: Frest & Johannes, 1995a). Similar recommendations were a part of the first and second yearly reports for this project (Frest & Johannes, 1994d, 1995d, 1996a). Mollusk diversity in the drainage is unusually high; there are nearly 30 precinctive and regional endemics. The Lake represents the best surviving pluvial lake in the western US, with the most intact biota, despite considerable modification. It is the best US example of an ancient lake system.

DEFINITION

As used herein, the Upper Klamath drainage includes Upper Klamath Lake proper and drainages tributary to it, specifically the Lost, Williamson, Sprague and Sycan river drainages, mostly in Klamath Co., Oregon. We also include the Link River and that portion of the Klamath River in Oregon from the Cascades crest (*i.e.*, from Johnson Creek east) to Klamath Falls. The California part of the Lost River drainage is not included. Neither are the Oregon Interior Basin drainages or such problematic areas as the Goose Lake Basin. Information on these areas is summarized in Frest & Johannes (1995a, 1995b, 1998 [in press]). As tributaries, particularly springs, are often major focal areas of mollusk endemism, particular attention is paid to them.

The study area (See **Figure 1**) thus extends from the crest of the Cascades east of the Rogue and Umpqua river headwaters (coastal drainages) north to the Crater Lake area and just south of the adjoining Deschutes and John Day systems (Columbia drainage). On the east, internal drainages such as the Silver Lake, Summer Lake, and Lake Abert (Oregon Interior Basin) border the Upper Klamath; to the south and southeast, elements of the Sacramento system (Pit River) and Goose Lake fringe the Upper Klamath drainage.

ECOLOGY

Freshwater mollusks can inhabit permanent water bodies of all sizes; a few can tolerate conditions in temporary or seasonal situations as well. In terms of diversity, flowing water situations are generally most favorable, but lakes, in particular river lakes or spring-influenced bodies such as Clear Lake (Lake Co., California) or Upper Klamath Lake, may have exceptional faunas. In California, abundance, and sometimes diversity, is often highest in clear, spring-fed streams or large spring pools (limnocrenes: see **GLOSSARY**) with cold, well-oxygenated water, stable cobble-boulder substrate, and relatively minor aquatic macrophyte representation. Thus, prior to human modification-and to an extent still-the Upper Klamath Lake drainage provided exceptional mollusk habitat. Prior to the completion of various dam, reservoir, and impoundment projects, the lower and middle Klamath River and its tributaries also had a relatively diverse freshwater mollusk fauna. At present, this malacofauna persists in relatively free-flowing stretches of the river proper and in relatively undisturbed tributaries, for example the Jenny Creek area, Jackson Co., Oregon. The very large spring complexes (nasmodes) on the middle Klamath, such as Shoat Springs, and in the Upper Klamath drainage in particular those of the lower Williamson River, the Lost River at Big Spring, Duncan Springs, Kimball State Park, Tecumseh Spring, Barkley Springs, Spring Creek, Odessa Creek, and Short Creek, constitute exceptional freshwater mollusk habitat. Both lotic and lentic habitats are exceptional in the system. While sizable portions of the drainage, especially on the north end, have been covered with deep pumice and volcanic ash comparatively recently from a geologic viewpoint {from the 6-7,000 YBP Mount Mazama eruption that created Crater Lake], much of the central and southern portions of the area are eucrenic despite the general semiarid setting. Note that some of our sites, particularly in the north and in areas heavily affected by agriculture, yielded no mollusks (squares on **Figure 1**), most did (203 out of a total of 296 sites) .

The majority of freshwater mollusk species are sensitive to pollution (Burch, 1989) regardless of source. Relatively few North American species tolerate warm waters, low dissolved oxygen, or seasonal fluctuations. The major exceptions to this are certain pulmonates in the families Physidae, Lymnaeidae, and Planorbidae and some sphaeriid species. These eurytopic taxa are characteristically widely distributed; some are intercontinental in occurrence. Most Upper Klamath species (especially endemics), however, are cold-water forms preferring clear and cold, unpolluted waters with dissolved oxygen (DO) levels near saturation. Most such stenotopic and stenothermal taxa are quite sensitive to hypoxic or anoxic conditions, in either the water column or substrate: certain lymnaeids and sphaeriids and a few unionaceans are the major exceptions. Very few of the native cold-water species can tolerate algal blooms or dense macrophyte stands; and they also avoid or are excluded from areas with major diurnal DO and temperature fluctuations.

Most Upper Klamath drainage freshwater snails are grazers, largely of aufwuchs on stones. Most such species thus feed upon attached diatoms and smaller epiphytic algal taxa. The majority are best characterized as obligate perilithon feeders; a few can also (or prefer to, in some cases) graze periphyton, and a small number can also feed upon larger aquatic macrophytes. Some species, notably including *Valvata humeralis* and *Helisoma (C.) newberryi*, are obligate or facultative detritivores, often occurring on or in oxygenated mud substrates. Particulars for some taxa may vary. Certain *Fluminicola* and *Juga* species, for example, can eat seasonally infallen waterlogged deciduous tree leaves, even though the perilithon habit is more typical for the genera involved. The freshwater clams are filter feeders, extracting diatoms, other unicellular organisms including bacteria, and fine organic detritus from the water column. The larger bivalves are mostly very sensitive to low oxygen conditions and water chemistry; they concentrate heavy and transition elements when present, and have also been shown to concentrate organochloride herbicides, pesticides, and certain viruses. Their ability to lower metabolism and close their valves gives them some protection from event disturbances. Sphaeriids (the small so-called fingernail clams) vary considerably in habitats and requirements. Many of these small bivalves are eurytopic, widely distributed, and relatively pollution and disturbance-tolerant; but certain species are members of the cold-water group (notable examples here include *Pisidium (C.) ultramontanum, Pisidium (N.) punctatum, Pisidium (P.) idahoense, and P. (C.)* n. sp. 1) These taxa are reasonably considered comparatively stenotopic. Most unionaceans (the larger bivalves) prefer sand-gravel substrate, while many sphaeriids prefer mud-fine gravel. Certain freshwater snail species may be especially sensitive to disturbance. The Pacific Northwest endemic family Lancidae, for example, lacks either lungs or gills and has modified the shell shape into a limpet-like form. Respiration is accomplished entirely through the mantle; and all species seem especially sensitive to DO fluctuations or to hypoxic or anoxic conditions. The Upper Klamath form *Lanx klamathensis* Hannibal, 1912 is a local example.

In the Pacific Northwest, with its numerous oligotrophic mountain streams and springs, a number of species are specifically adapted to the typical habitat. These have been termed "cold water biota" in Idaho; they are of especial interest in that many of the region's endemic and threatened and endangered taxa fall into this group, and preservation of cold water biota is a designated major goal of water quality regulations. In Idaho, five such taxa from the middle Snake River have recently been added to the Endangered Species list (USFWS, 1992b), after extensive study (Frest & Bowler, 1993; Frest & Johannes, 1991a, 1992a, b, c; 1993c, d). Habitat characterization for these taxa is the same as that for many Upper Klamath drainage forms: "[a]ll require exceptionally well-oxygenated, clean, water. They are currently restricted to areas with unpolluted, cold, clear, flowing water, and are intolerant of impoundments; turbid water; slack water; water with substantial quantities of dissolved herbicides, pesticides, nitrates, or phosphates; water with substantial quantities of suspended fine sediment; habitats with unstable substrate, regardless of particle size; hypoxic conditions, regardless of cause; and areas subject to frequent water level fluctuations. None are typically river edge [amphibious] or lentic species; all prefer lotic habitats" (Frest & Johannes, 1992b, p. 8). Of the taxa listed in Table 1, the following likely fall into the cold water group: *Valvata humeralis*, all *Pyrgulopsis* species; all *Lyogyrus* species; all *Fluminicola* species; *Stagnicola montanensis*; all *Lanx* species; *Helisoma (C.) newberryi*; all *Vorticifex* species; the larger bivalves; *Pisidium (P.) idahoense*, *P. (C.) contortum*; *P. (C.) pauperculum*; *P. (C.) ultramontanum*; *P. (N.) punctatum*, and *P. (C.)* n. sp. 1 (= Modoc Plateau peaclam of Taylor & Bright, 1987).

In general, limnetic habitats are very favorable for freshwater mollusks. There are a few strict limnocole (lake-restricted) taxa in the Upper Klamath drainage. Examples include *Pyrgulopsis archimedis*, *Pyrgulopsis* n. sp. 1, and *Vorticifex effusus dalli* (for more complete discussion, see below; see also Table 7). More common are limnophile species, such as *Vorticifex klamathensis klamathensis*; *Lyogyrus* n. sp. 4; and *Pisidium (C.) ultramontanum*. Quite a few taxa are restricted to or most common in limnocrenes. These include several *Fluminicola* species, of which *Fluminicola* n. sp. 1 is a prime example; many of the limnophiles; and such taxa as *Pisidium (C.) ultramontanum* and *P. (C.)* n. sp. 1. As in other parts of the US, there are a few amniphile taxa in the Upper Klamath Lake [hereafter UKL] system also. As regards large-river taxa, the preeminent examples here are probably certain of the larger *Fluminicola* species, *Pisidium (C.)* n. sp. 1, and *Lanx alta*. *Pyrgulopsis* n. sp. 2 is probably an example also (Table 7). The river form of *Juga (O.) nigrina* is another amniphile; but this taxon seems to prefer smaller rivers and streams. Some large bivalves, such as *Margaritifera falcata*, are essentially amniphiles. For the majority of the cold-water stenotherms, spring-related environments in the broad sense are typical; and many are cold spring crenocoles or at least crenophiles.

Elsewhere in the western US, there are also warm spring (thermocrene) stenothermal taxa (thermicoles or thermiphiles), particularly in the Hydrobiidae; however, none have yet been found in the Upper Klamath drainage, even though some occur in the nearby Great Basin drainages (Hershler, 1994, 1995, 1998), including at least two in the Oregon Interior Basin. Most freshwater species have narrow salinity tolerances (this does not necessarily hold on the generic or family level, particularly for such families as the Hydrobiidae), and most freshwater forms are not tolerant of acidic or very alkaline waters: they prefer slightly alkaline habitats. Here again some Physidae, Planorbidae, or Sphaeriidae are the most prominent exceptions. As regards pH, many species prefer slightly alkaline waters. These are generally derived from calcareous strata and the regolith resulting from their weathering, *i.e.* such sedimentary units as limestone and dolomite. Diversity is often lowest on basic igneous rocks such as granites. Many of the native cold-water taxa prefer or are restricted to coarse substrate (*i.e.*, are lithophiles). A few forms are pelophiles; good exemplars of the preference for muddy substrate are *Helisoma (C.) newberryi* and *Pisidium (C.) ultramontanum*. These two species are also stenothermal forms, requiring oxygenated soft substrate. This combination of preferences considerably restricts possible occurrence of these taxa under current conditions; however, both have extensive late Pliocene-Pleistocene fossil records (see Taylor, 1985; Taylor & Bright, 1987), indicating former widespread prevalence of this habitat in portions of the western U. S.

Some forms, particularly hydrobiid snails, may live only in phreatic waters, such as in subterranean caves, and may be only accidentally or not at all represented in epigean environments. These taxa often live in very low nutrient, low DO situations, generally in areas with extensive limestone karst, a landform not well represented locally.

LIFE HISTORY

Western US freshwater mollusks pursue more than one life history strategy. While particular strategies may be typical of certain families, this must be evaluated on a species by species basis. Many of the cold water forms are semelparous breeders and have single-year life spans. Other taxa, such as *Valvata*, may sometimes live for two years. *Juga* is thought to have a life span of 5-7 years and to reach maturity in 3 years (Furnish, 1990). Certain of the pulmonates are iteroparous breeders and may live for several years: but the Lancidae have 1-year life spans and are semelparous. Most Northwest Hydrobiidae (*Fluminicola*, *Lyogyrus*, *Pyrgulopsis*, *Pristinicola*) are short-lived and semelparous. Most Sphaeriidae are short-lived (essentially one year), but many are iteroparous, even though broods are often small. Unionacean bivalves have long life spans and are semelparous, often with comparatively long annual breeding seasons.

Almost all of these large bivalves have a parasitic larval stage (the glochidial stage) resident for some weeks on the gills of freshwater fishes; they are dependent on the fish for distribution and successful completion of their life cycle. Host specificity varies from species to species; some are quite species specific. Thus, fish host distribution is as vital to their survival as is availability of proper subadult and adult habitat.

The breeding season for many of the Pacific Northwest cold-water snails appears to be between February-May, with egg laying and hatching taking place between March-July. Details and precise timing vary from species to species; but eggs are quite often laid about 1 month after copulation, and the eggs often hatch about one month after they are laid. Cold-water stenotherm breeding adults commonly die shortly after laying eggs. Metabolism varies seasonally and diurnally, with greater activity in the spring and summer and in the daytime. Certain species, particularly of freshwater snails, are also strongly photophobic. Seasonality, both in regard to metabolic rate and reproduction, appears to apply to river species more than to spring forms, but is still pronounced. Some species are quite sensitive to variations in insolation or to physical disturbance, often releasing their hold on the substrate if disturbed. Some species are relatively active; but the majority (even of the active forms) do not voluntarily travel far from their place of birth, and thus are sessile for all practical purposes. This is particularly true for the predominantly or totally perilithon feeders, such as *Vorticifex*, *Lanx*, and *Fluminicola*, and even some of the eurytopic types (such as many Physidae) may not travel far in flowing water habitats.

Given the foregoing, many Pacific Northwest freshwater mollusk species, particularly the cold water forms, can be characterized overall as stenotopic. As annual population turnover in most freshwater mollusk species is considerable (*e.g.* 90% or more for the hydrobiid *Fluminicola fuscus* and the lancid *Fisherola nuttalli*: Coutant & Becker, 1970 and unpublished data), and many breed only once, they can be quite vulnerable to major disturbance events. In disturbed streams, mollusks may be disproportionately affected: this often makes them particularly effective indicators of pollution and other forms of environmental disturbance. With so many streams in the Pacific Northwest affected by human modification (Benke, 1990), mollusks and their role in the ecosystem are often overlooked. In undisturbed habitats they are often extremely abundant, and in fact frequently dominate the invertebrate fauna in terms of biomass and number of individuals. The genus *Juga*, for example, may comprise more than 90% of the total invertebrate biomass in some streams (Hawkins & Furnish, 1987). Similar densities are often encountered in Northwest lotic settings with the genera *Fluminicola*, *Vorticifex*, *Pyrgulopsis*, *Lanx*, and *Corbicula*. Sphaeriids are also often very abundant (often dominant) in soft substrate communities. Examples of all of these occurrences (with the exception of the introduced *Corbicula*) still can be readily found in the Upper Klamath drainage, particularly in the lower Williamson River and the springs surrounding Upper Klamath Lake. Similar densities of the large bivalves *Gonidea* *angulata* and *Margaritifera falcata* have been seen elsewhere in comparable settings: the best example to date in this area is the lower Williamson River.

ROLE OF MOLLUSKS

Mollusks mostly fill the role of primary herbivores in freshwater aquatic ecosystems. The perilithon and periphyton feeders are very significant in terms of controlling growth of epiphytes. Some taxa are significant consumers of the larger aquatic macrophytes. Detritivore genera such as *Helisoma* and *Valvata* play a very significant role in recycling of organic detritus. The freshwater bivalves are primary phytoplankton and zooplankton feeders. In turn, these mollusks serve as food to a variety of freshwater fish, including game fish. Examples include native trout, native salmonids, Dolly vardens, whitefish, sturgeon, and some sculpins and squawfish. Snails and smaller freshwater bivalves are also commonly consumed by larger aquatic insects, particularly larval forms, leeches, and by a variety of birds, including ducks, geese, herons, and cranes. Large freshwater clams (and some snails) are avidly eaten by raccoons, muskrats, otters, and beavers. These mollusks were utilized extensively for food, tools, and ornament by Native Americans as well; there are well-known local examples. Sphaeriids are consumed in vast numbers by bottom-feeding fish such as sturgeon and whitefish and by most water birds as well. The wide distribution of these small clams in aquatic environments has assured their utilization as a food resource by a variety of animal groups. Specialized species inhabit both warm and cold springs, temporary (including woodland vernal) ponds, swamps, sloughs, and backwaters, as well as the more preferred cold and clean permanent-water habitats. For basic ecology and biology (although with an eastern US slant), recent papers by Brown (1991: gastropods) and McMahon (1991: bivalves) are useful. See also discussion of all of the foregoing in Frest & Johannes (1995a; 1998, in press).

DRAINAGE HISTORY

The historic and current freshwater mollusk fauna of the Upper Klamath drainage can only be understood completely in relation to its biogeography. Faunal biogeography, as has become evident in recent years, is intimately connected to its geologic context, especially in regard to tectonics and lithostratigraphy. As it happens, the biota, particularly as reflected by freshwater fishes and mollusks, has often yielded clues as to a river system's development, if not the timing of major changes. Similarly, information on regional geologic history often yields information or defines constraints on drainage and faunal history. The literature is scattered, and will only be summarized briefly here. The best references for the local fauna are Taylor (1985) and Taylor & Bright (1987), and much of the following discussion is adapted from these works. The radiometric date framework for the region derives from Sarna-Wojcicki (1976).

It is well established that the current Snake River system of Washington, Oregon, Idaho, and Wyoming is composite. The Washington Snake and Hells Canyon were until the Pleistocene part of the Columbia drainage (Clearwater River). The current middle Snake River of Idaho for some time was connected to various Pacific drainages, notably the Klamath and Sacramento. The ancient Snake-California connection was first suggested by ichthyologists (Hubbs & Miller, 1948); some later works arrived at similar conclusions (*e.g.*, Miller, 1959, 1965; Miller & Smith, 1981; Smith, 1975, 1978, 1981). Geologists and malacologists reached parallel conclusions (Wheeler & Cook, 1954; Taylor, 1966a; 1985; Taylor & Smith, 1981; Taylor & Bright, 1987; Repenning, Weasma, & Scott, 1995), based upon different lines of evidence. Various connections have been suggested, including the Klamath, Sacramento-Pit, and Sacramento-Feather systems. The most likely course (Taylor, 1985; Taylor & Bright, 1987) was through the Harney and Malheur Lake basins, thence to the Warner Lakes area, and thence to northeastern California and southwestern Oregon.

The basic scenario for the Late Cenozoic (the last 18 million years) can be summarized as follows. Some connection between the Sacramento-San Joaquin was established as early as the late Miocene, as indicated by fossil freshwater fishes (Smith, 1975, 1981) and mollusks (Taylor, 1985). In early Pliocene times (perhaps 3.5-4.0 MYBP), the upper Pit River (above the Falls) was a tributary of a Snake River that flowed northwestward to the Pacific. The likely connection was to the Klamath River in the Upper Klamath Lake region (Taylor & Bright, 1987). The somewhat smaller Sacramento system flowed south to a marine-freshwater embayment in the southern San Joaquin Valley. A diverse endemic fauna developed in the lower Sacramento-San Joaquin Valley that mostly became extinct by the early Pleistocene. Endemism also developed in the Pit and Upper Klamath drainages, then conjoined. By later Pliocene times (prior to 1.5 MYBP) the embayment had vanished, and the Sacramento River now flowed into Monterey Bay. In early Pleistocene times (perhaps 0.7-0.75 MYBP) there was a short-lived large lake in the San Joaquin Valley, and the San Joaquin had joined the Sacramento system. Species typical of the more northern drainages now invaded the San Joaquin for the first time, indicating that the Pit had by now been added to the Sacramento system. Interestingly, there is little indication of headward migration of forms from the lower Sacramento system, specifically above the Pit River Falls; and no indication of transfer of such forms to the Upper Klamath drainage.

By early Pleistocene times the former Snake River system was disrupted by block faulting related to the more extensive tectonics of the Basin and Range. Extensive sheet basalt flows characterize the northern periphery of the Basin, generally just outside the current Lahontan internal drainage. The result was the formation of numerous small internal drainage basins in southeastern Oregon and extreme northeastern California. Lahontan elements spread into some of these Basins during the Pleistocene, and some Snake River elements invaded Lahontan drainages, particularly east of the Sierra Nevada Mountains. The Klamath, Sacramento, and Snake systems assumed their present configurations at about this time, and extensive lakes formed in various of the now-internally draining Lahontan and peripheral basins. Considerable fluctuations of lake levels occurred during the remainder of the Pleistocene; in more recent years (4-6,000 YBP to the present), the overall effect has been reduction in lake volume and numbers.

Vigorous speciation has taken place in the Lahontan and peripheral basins, most undoubtedly pre-Pleistocene. Existing species with fossil records extend back as far as the Miocene, and many were definitely present in the Pliocene. Species swarms are most evident in the genera *Fluminicola*, *Pyrgulopsis* and *Tryonia*; a similar local diversification occurs in *Lyogyrus*. Several of these endemic clusters have been described only very recently, and the process is ongoing: major works are Taylor (1966b), Hershler (1985), Taylor (1987), Hershler & Landeye (1988), Hershler & Sada (1987), Hershler (1989), Hershler & Thompson (1991), Hershler & Frest (1996), and Hershler (1994, 1995, 1998). Location of these groups gives some clue to former stream connections. *Tryonia* occurs from southern California across Arizona and New Mexico and southern Nevada and Utah east to west Texas, with peripheral sites in northern Mexico and Florida. *Pyrgulopsis* (*s.l.*) occurs in much the same area in the western US, but extends north to the periphery of the Great Basin and Snake River Plain, *i.e.* southeastern Oregon, southern Idaho, and western Wyoming and Montana, with occasional disjuncts elsewhere (see Frest & Johannes, 1995a, fig. 12; 1998, in press).

The *Pyrgulopsis* species group that Gregg & Taylor (1965) segregated as *Fontelicella*, especially species related to *P. intermedia*, occurs on the Lahontan periphery, *i.e.*, in the Snake River system in western Wyoming, southern and central Idaho, southwestern Oregon, on the Oregon-Washington border, and in northeastern California. The westernmost and southernmost occurrences are in the Upper Klamath system and in the Sacramento system (Pit and its tributaries). *Pyrgulopsis* is not particularly speciose in the UKL area, especially as compared to the core Lahontan (see, *e.g.*, Hershler, 1998). The two undescribed *Pyrgulopsis* species recognized here are both members of the *intermedia* group. The remaining species, *P. archimedis*, is probably closely related both to *intermedia* and to the likely extinct genotype, *P. nevadensis*. It is notable because it is the only surviving large lake species. During the Miocene and Pliocene, many of the large Western Interior pluvial lakes had endemic lake species (for discussion, see Frest & Johannes, 1998, in press).

Occurrences of so-called *Lyogyrus* here deserve special comment. Until recently, amnicolinid hydrobiids were thought to be absent or extremely rare in the western US (see, *e.g.*, Hershler & Holsinger, 1990, for an example). As yet there is in fact only one described taxon. However, in the past 10 years we have found a number of taxa, generally of rare occurrence, in the western US (see Frest & Johannes, 1998, in press for extended discussion). Currently, western amnicolinid sites are mostly on Pacific Coast, the Columbia Gorge, and notably on the northern periphery of the Great Basin, often coinciding with the distribution of *intermedia*-group *Pyrgulopsis*. Examples include localities in the Blue Mountains, the SE Idaho-western WY-NE Utah area, and the Klamath and upper Sacramento systems. *Lyogyrus* obviously does not occur throughout the Sacramento or Klamath systems, but only in the headwaters: in the Sacramento system in the Pit and its tributaries and around and in Upper Klamath Lake. Species in these areas seem distinct from other western occurrences (Frest & Johannes, 1995a, 1998, in press; see also Map D9 (**APPENDIX D**) herein).

Recent anatomical work indicates that few or none of the western amnicolinid species belong to described genera. The western forms examined so far all have paucispiral operculae and the penial lobe diverges from the filament very near the base; at least some, perhaps all, also seem to have a bursa copulatrix and an additional two seminal receptacles. A new genus or genera will be necessary for these forms. For the moment, because of external resemblances, we refer to these taxa as belonging to the eastern genus *Lyogyrus*.

A short-lived connection between the ancestral Snake system and the Columbia Basin has been suggested by Allison (1966) and Taylor (1985). Most likely conduits during Pleistocene high lake stands from the interior drainages and pluvial lakes of southeastern Oregon to the lower Columbia River would be either the Deschutes or John Day Rivers, presumably *via* the Upper Klamath drainage. Taylor (1985) suggests that *Anodonta wahlametensis* and *Vorticifex effusus effusus* may have entered the Columbia system by means of this route comparatively recently. Some evidence of such a connection remains, such as occurrences of small *Fluminicola* species in the Deschutes system (Taylor, 1985), and an occurrence of *Stagnicola apicina* in the Fossil Lake beds of Oregon. Original and long-lived separation of the Columbia and more southerly drainages was suggested by Taylor (1966a, 1985) because of the existence of species pairs in the two areas. Miocene examples occur in the freshwater snail genera *Bellamya* and *Juga* (*Calibasis*). The modern pairs *Vorticifex effusus effusus* and *V. neritoides* and *Fisherola* and *Lanx* may be similar cases. We would also suggest species swarms in the snail genus *Juga (Oreobasis)* in the Deschutes River and Columbia Gorge (largely undescribed) *vs.* the Great Basin, southwest Oregon and northern California (mostly described) as another example (see Frest & Johannes, 1995a for further discussion).

Another implication of the large number of endemics noted herein is that the present connection to the Klamath River *via* the Link River may be relatively recent. *Juga*, for example, is quite prevalent in the large and small streams lower in the Klamath system; but barely makes its presence felt in the UKL (see Map D7 herein). The common Klamath River taxon is *Juga (J.) silicula shastaensis*: this does not occur in the UKL at all. UKL taxa so far are all *Oreobasis*, possibly endemic (this requires further study). The common Klamath River *Lanx* is *Lanx alta*: while we recognize this form here in rivers (see, *e.g.*, Map D8), it is quite possible that the Williamson and Sprague occurrences, *i.e.*, all but one UKL site, belong to an endemic, undescribed taxon. Until we complete more detailed study, however, we leave these occurrences in *L. alta*. The endemic UKL lake-limnocrene form, *L. klamathensis*, is almost entirely restricted to the UKL and immediate vicinity (Map D8 herein), with the exception of one old site, now apparently extinct, near Klamathon. Evidently, this taxon did not make it far down river.

On the other hand, *Fluminicola* is abundant and widespread in both areas. One taxon, *Fluminicola* n. sp. 1, may occur downstream at least as far as Hornbrook, California. However, other large *Fluminicola* species are quite distinct in the two areas. Small *Fluminicola* are prevalent in both the UKL and the middle Klamath; but the taxa seem to be entirely different, with but one possible exception, *Fluminicola* n. sp. 13. Several of the UKL taxa are very narrow endemics (see **APPENDIX D**, Map D3 for examples) and most are confined only to portions of the total drainage, such as the Lake itself, the area on the NW side of UKL; the area on the NE side of UKL; the Williamson and Sprague rivers; or the Lost River (see Maps D2, D4, D5 for examples). Perhaps more significantly, there is one species group, probably deserving separate generic status, confined to the UKL drainage. These forms, large and small, have a penis that is strongly alate on the left side. So far, no such taxon is known outside of the UKL. By accident, a form from the UKL with this morphology was wrongly ascribed to the Willamette River and illustrated as typical of the genotype, *F. nuttalliana* (for discussion, see Hershler & Frest, 1996; for illustration, see Stimpson, 1865a & b).

MOLLUSK BIOGEOGRAPHY

As may be inferred from the foregoing, the modern freshwater mollusk fauna of the Upper Klamath drainage is composite. At present, the system is bordered on the north by parts of the Deschutes and John Day systems (Columbia drainage). The western periphery interfingers with the Rogue and Umpqua systems, mostly in the area of Crater Lake (**Figure 1**). On the eastern margin are situated portions of the Oregon Interior Basin. To the southeast, the Upper Klamath drainage borders the California and Nevada Great Basin, now occupied by a series of small internal drainage systems. Notable among these is the Goose Lake basin, which in high water years may connect to the North Fork Pit River. Because the fish fauna of the Goose Lake basin seems quite distinct from both that of the Upper Klamath and the Pit drainages, and the affinities of much of this fauna are with the Great Basin, this area is generally grouped by biogeographers with the Great Basin. To the south, the Upper Klamath drainage interfingers with the Pit drainage.

In order to assess relationships of the Upper Klamath drainage freshwater mollusks, we found it necessary to consider the malacofaunas of the peripheral drainages in some detail. This became especially necessary as the number of new and rare taxa mounted. To properly assess their status, it is imperative to determine their full possible rage. To do this we first reviewed the literature. We have also conducted fairly extensive fieldwork in the peripheral drainages in the period between 1990-1995; and this work is ongoing. In particular, a recent survey of the Upper Sacramento system should be mentioned (Frest & Johannes, 1993a; 1994a, b; 1995b; 1996b), as well as the Tuscarora Pipeline survey (Frest & Johannes, 1994c), which involved part of the Upper Klamath drainage. R. Hershler also made available published and unpublished results of his and his collaborators' fieldwork in northeastern California and Interior Oregon (examples include Hershler, 1992, 1995, 1998). As nearly all such research was considered outside the direct purview of our contract, none of this work was billed to this contract; and it is not reported on except in passing here. It is relevant, however, in that failure to find many of the Upper Klamath drainage endemics in these areas after modern survey emphasizes the unique aspects of this drainage's fauna, and emphasizes the rarity of the endemic taxa.

A problematic area is the Goose Lake drainage. Because of the equivocal position and relationships of this drainage, we do not at present list any of our sites and their faunas from the Goose Lake area (collected recently for other projects]. Had all peripheral sites for which we have recent data been included, the size of this report would have more than doubled. Still, we freely use this data where necessary to assess status and identity of some of the Upper Klamath drainage taxa. Some of this information is or will soon be available in the Interior Columbia Basin report (Frest & Johannes, 1995a), the last Upper Sacramento report (Frest & Johannes, 1995b, 1996b), in Hershler & Frest (1996), or in Hershler (1995, 1998). For additional data, contact the authors.

As noted by Taylor (1985) and Taylor & Bright (1987), the Upper Klamath drainage and adjoining areas have had a complex Late Cenozoic history, traces of which are still reflected in the fauna; and certain species can be ascribed to specific points of origin. Significant species are discussed below individually. Mollusk biogeography in this area is complex. The fauna of the Klamath River below the Link River is quite distinct from that of the rest of the system. Various species seem to be endemic to Upper Klamath Lake proper. Apparently, certain taxa are restricted to the Williamson or to the Lost River drainages. Even on Upper Klamath Lake, there is some differentiation between spring faunas on the northwest and eastern periphery (see Maps D2, D5 for examples in *Fluminicola*).

For the purposes of this report, the current Upper Klamath drainage malacofauna (Table 1) can be divided into several groups. One is common throughout much of North America. This is the largest single group here, as elsewhere, and includes approximately 36 formerly described native and 2 introduced species out of the 73 that have been ascribed to the Upper Klamath (Table 1). We have not made especially comprehensive efforts to locate these species, as none are of conservation significance. Nevertheless, such taxa are commonly encountered in the habitats we searched particularly heavily. The other groups embrace more geographically restricted forms. The second covers about 26 species likely to have originated in Upper Klamath Lake and immediately adjacent drainages, and largely or entirely restricted to it now. This group would include a number of endemic *Fluminicola* and *Lyogyrus* species, as well as such taxa as *Lanx klamathensis*. The third involves 5 species likely to have originated in, or at least recently are largely confined to, the Great Basin and peripheral internal drainages. This group includes the species associated with the course of the former Snake River. A few species seem to occur only in the Lost River and its tributaries. Some of these taxa have nearest relatives in the Pit River drainage: with further study, these may be included in the Great Basin group. A few species seem to be restricted to the Williamson and Sprague rivers and their tributaries. Finally, a few species appear to be endemic to the northwestern or northeastern periphery of Upper Klamath Lake. These typically have sister species that occur in the Pit River or its tributaries.

The freshwater malacofauna of the Upper Klamath drainage is evidently quite distinct from that characteristic of most Pacific Northwest coastal streams. The high rates of endemism and the Great Basin element have few close parallels in surviving lakes; the fossil faunas of some of the extinct Miocene to Pleistocene lakes provide closer parallels (see discussion in Frest & Johannes, 1998, in press). In general, coastal rivers of Alaska, British Columbia, northern Washington, and some of Oregon were strongly affected by Wisconsinan continental or mountain glaciation and have few endemic forms. From about Olympia, Washington southward, the presence of one or two species of the freshwater snail genera *Fluminicola* (generally either so-called *nuttalliana*, *virens*, or related species: see Hershler & Frest, 1996, for modern discussion of species identities: most literature citations are wrong) and *Juga* (subgenus *Juga*; generally either *silicula* or *plicifera*) is characteristic.

In extreme southwestern Oregon and northwestern California, there are substantial changes in the fauna. The endemic western North American freshwater pulmonate family Lancidae occurs in the Rogue, Umpqua, Klamath, Sacramento, and related drainages, with one species disjunct to the Columbia system and another endemic to large spring complexes in the middle Snake River drainage only. The earliest fossil record for the family is from Cretaceous units in Nevada; and most fossil records (Pliocene-Pleistocene) are from the Great Basin and peripheral areas. Endemic modern taxa occur in the Columbia Basin, Washington, Oregon, and Idaho (listing candidate *Fisherola nuttalli*); middle Snake River, Idaho (the Endangered *Lanx* n. sp.); the Umpqua River, Oregon (*Lanx subrotunda*); the Rogue and Klamath Rivers and vicinity, Oregon-California (*Lanx alta*); Upper Klamath Lake, Oregon (*Lanx klamathensis*); and the Sacramento system (*Lanx patelloides*).

Taylor (1985) and Taylor & Bright (1987) noted similarities in the freshwater mollusk faunas of the Upper Klamath system and the Pit River. They also noted, however, the existence of several lake forms in Upper Klamath Lake that for habitat reasons have no parallels in the Pit (and hence Sacramento drainage). Similarities include the presence of such Snake River-related (peripheral Lahontan or Great Basin) forms as *Helisoma (C.) newberryi*, lotic species of *Lanx* (*alta* and *patelloides* respectively), species in the *Juga* subgenus *Calibasis*, certain small *Fluminicola* species, *Pisidium (P.) ultramontanum*, *P. (C.)* n. sp. 1, and western occurrences of *Pisidium (N.) punctatum*. We would add some others. While Taylor did not note species pairs in the Upper Klamath *vs.* the Pit, such may occur. For example, one Upper Klamath species of *Lyogyrus* is very similar to the ancestral Snake drainage form *Lyogyrus greggi*; this species may not have a Pit counterpart. However, a second new species of *Lyogyrus* from the Upper Klamath Lake area has a close Pit tributary congener (Frest & Johannes, 1995b). Similarly, a *Fontelicella*-group species very similar to *intermedia* occurs in the Upper Klamath area; related *Pyrgulopsis* species occur in the Pit drainage. At last one Upper Klamath drainage *Fluminicola* species is similar to the Sacramento *F. seminalis*. We have recently been collecting *Fluminicola* over the whole range of the genus as part of a systematic revision (with R. Hershler, NMNH). Among the findings are a number of small species, often spring-dwellers, with distinctive soft, and often shell, morphology. These forms correspond morphologically and ecologically to the southeastern US *Somatogyrus* group and *Gillia altilis* and to the Great Basin swarms of endemic *Pyrgulopsis*. Most species occur in southwestern Oregon and northwestern California. The species in the Upper and Middle Klamath systems and Upper Sacramento system appear to be mostly distinct, but are clearly closely related. The group with an alate penis, however, does not occur in the Sacramento system. One difference between the Pit and the Upper Klamath drainages is the general rarity of *Juga* in the latter. This genus is also fairly widespread in the northeastern California Great Basin, so that its rarity here is puzzling; but perhaps reminiscent of the generally sparse distribution of *Pyrgulopsis* in much of California (Hershler, 1995). The endemic swarm of *Vorticifex* forms in the UKL (four: *V. effusus dalli*; *V. effusus diagonalis*; *V. klamathensis klamathensis*; and *V. klamathensis sinitsini*) is without close parallel elsewhere; but there are one or two endemics in this pulmonate genus in the Upper Sacramento system as well.

There are probably some relations also with the Rogue and Umpqua systems of southwestern Oregon (*e.g.*, *Lanx alta* and *L. subrotundata*; they also share the Klamath River *Juga (J.) silicula shastaensis*); but indications are that the malacofauna of these two systems, while very different from those immediately north and definitely related to those of the Sacramento and Klamath (as witness the presence of Lancidae) are relatively depauperate and contain comparatively few endemics (Taylor, 1985 and our research to date). We have recently found small species of *Fluminicola*, however, in the headwaters of both systems that are reminiscent of those in both the Sacramento and Klamath drainages, *s.l.*

Outside of the Upper Sacramento system, the closest analogue, both taxonomically and ecologically, to the Upper Klamath drainage fauna is probably that of the middle Snake River, Idaho. The prevalence of oligotrophic lotic habitats with predominantly cobble substrate, basalt bedrock (in the Pit and middle Snake), and large spring complexes (nasmodes) are striking. Large-lake habitats are absent from the middle Snake, although this area had very extensive examples in the Pliocene and Pleistocene. As noted above, certain modern Snake River forms are thought to derive from the Sacramento system *via* the Upper Klamath (for example Pliocene Lake Idaho *Lanx* n. sp. aff. *patelloides* and modern *Lanx* n. sp.), and the relationship between the ancestral Snake system and Pliocene Lake Idaho and the upper Sacramento and Upper Klamath drainage has been discussed previously. Faunal similarities include the presence of local endemic river and spring hydrobiids and lancids, and the overall aspect (see Frest & Bowler, 1993, for list) is very close. The middle Snake, however, now lacks pleurocerids, although these (including the Sacramento-Klamath-Great Basin periphery subgenus *Calibasis*) were present in the Pliocene (Taylor, 1985). We have previously used the large spring complexes of the Pit River and Upper Klamath Lake as the closest modern analogy to Pliocene Lake Idaho, and compared the modern middle Snake River alcove spring complexes to the Fall River-Hat Creek springs (Frest & Johannes, 1992b).

It should be noted here that the mollusk species groups defined above often have parallels in other animal groups, in particular fish. Traces of the ancestral Snake system still survive in the Great Basin, Upper Klamath, and Sacramento, for example as reflected in the modern and fossil distribution of the sucker genera *Chasmistes* and *Deltistes* (Miller & Smith, 1981). The Snake-Great Basin relationship has been discussed by Smith (1978), Minkley, Hendrickson, & Bond (1985) and Sigler & Sigler (1987). The Sacramento-Snake connection as evidenced by fossil fish distribution has been described by Smith (1978, 1981) and Taylor & Smith (1981). Some notable parallels in the recent fauna should be noted here (distributions from Moyle, 1976; Moyle *et al.*, 1982; and McGinnis, 1984). The formerly widespread (in the Great Basin and peripheral drainages) sunfish genus *Archoplites* in modern times lived naturally only in the lower Sacramento and San Joaquin. The brook lamprey *Lampetra lethophaga* suggests a Pit-Upper

Klamath connection. The related species *L. folletti* is a Klamath endemic. The closely related Modoc and Sacramento suckers *Catostomus microps* and *C. occidentalis* may provide another example. The tui chub *Gila bicolor* occurs in the Lahontan and peripheral drainages, the Klamath, and the upper Pit River, including Goose Lake. Among the sculpins, the Pit River endemic Rough sculpin *Cottus asperrimus*, the Upper Klamath-Pit Marbled sculpin *C. klamathensis*, the Sacramento-San Joaquin [and a few coastal streams] Riffle sculpin *C. gulosus*, and the Upper Sacramento-Pit River (Upper Sacramento system as used herein) Pit sculpin *C. pitensis* have distributions parallel to the previously discussed mollusk groups.

Some workers have formally defined biotic provinces based on fish distribution (Moyle, 1976; McGinnis, 1984). Such units as the Sacramento Province, the Klamath Province (with two subprovinces, Upper and Lower, formally separated at Klamath Falls), and the Lahontan Province have direct mollusk parallels, as discussed above. For example, in *Fluminicola*, *F. turbiniformis* [as defined by Hershler & Frest (1996)] is mostly peripheral Lahontan. However, the closely related *Fluminicola* n. sp. 16 [herein and in Frest & Johannes, 1998, in press: n. sp. 10 of Frest & Johannes (1995b, d, 1997) and a sister species have sites in the Upper Sacramento and Upper Klamath systems. Similarly, there are small parallel species swarms, separate but related, in the Upper Sacramento and Upper and Lower Klamath drainages. Given the major differences in trophic level and life history between mollusks and fish, drainage changes related to major tectonic events are the most likely explanation for convergences in distribution, particularly of the many narrow endemics. This connection has been noted repeatedly in North America, and has been documented extensively elsewhere, for example in desert fishes and snails of the Great Basin. A recent interesting extralimital example is Florida (Hoeh et al., 1996). Ash Meadows and other Owens and Amargosa River (Death Valley) faunas, California and Nevada, and Arizona and New Mexico faunas provide well-documented examples (for mollusks, see Taylor, 1987; Hershler & Sada, 1987; Hershler & Landeye, 1988; and Hershler, 1989; for fish, see numerous articles in Minkley & Deacon, 1991). Similar relationships may exist also in crayfishes, *e.g.* the Endangered Pit River *Pacificastus fortis* and other *Pacificastus* species. Even more remarkably, distribution of certain land snail species, particularly in *Monadenia*, *Vespericola*, and related genera, seems to parallel that of the freshwater forms. There are likewise related endemic clusters of vascular plant species in the Klamath and Siskiyou Mountains; but these do not have Snake River parallels.

The typical Upper Klamath drainage oligotrophic fauna still persists at a number of sites. Diversity at a single site is typically low-moderate (Table 3), in the range of 2-5 taxa. Species of *Fluminicola* (*s.l.*) are particularly characteristic. Both large and small forms, probably representing at least 13 species and 3 or more distinct lineages, are commonly present. Over much of the range, diversity of this genus is low (1 species per site); but here, two-species occurrences are quite common (Table 3). Very often, other hydrobiid taxa, such as species of *Lyogyrus*, may be present at the same site. As noted above, the genus *Pyrgulopsis*, predominant in the Great Basin, is comparatively rare here. One possibility is that the genus is a relatively recent immigrant into the system; however, those areas with *intermedia*-group taxa often have low *Pyrgulopsis* diversity regionally (Frest & Johannes, 1998, in press).

The pleurocerid genus *Juga* is also surprisingly rare in this drainage. Sphaeriid clams are widely distributed; but comparatively uncommon and not especially diverse as compared to the adjoining Upper Sacramento-Pit R. drainage (Frest & Johannes, 1995b). The overall aspect of Upper Klamath drainage faunas is very similar to that of the Upper Sacramento-Pit, in that *Fluminicola* is common and rather diverse; *Pyrgulopsis* is rare; similar *Lyogyrus* is found in both; and *Lanx* species are frequently encountered. *Juga* is much more widespread in the latter, however; and sphaeriid diversity is often greater. Perhaps as a result, the diversity of large Upper Sacramento-Pit nasmodes and limnocrenes tends to be slightly higher; but this may simply be an artifact of relatively better ground water quality in the California springs and spring ponds. Certainly, the relatively eutrophic nature of Upper Klamath Lake and its environs is striking in comparison with the Pit River nasmodes. This is interesting, in that geology is remarkably similar in both regions; and both share a similar geologic history (in fact, quite closely interrelated). Assertions are often made that eutrophic ground and surface water conditions are not the result of human agricultural and other practices but rather reflect the original state. Comparison of the Pit and Upper Klamath malacofaunas and their habitats quite simply does not support such an interpretation. Habitat diversity is actually greater in the Upper Klamath Lake region; and a larger proportion of surviving relicts would thus be inferred as likely to survive. There are no large water bodies comparable to Upper Klamath Lake in the Pit system; and no surviving lake-adapted species. It is tempting to conclude that deteriorating water quality in the Upper Klamath Lake area correlates with the slightly less diverse malacofauna. This inference is not supported by old collections, in that none are comprehensive enough to establish either faunal continuity or change. Study of Late Pleistocene or Holocene mollusk-bearing units could confirm or disprove this suggestion.

Much more study of the Lake's past history and biota is required before confident environmental interpretation can be made. Certainly, its very recent history indicates decreased water input; proportionately high and increasing amounts of dissolved nitrogen and phosphorous; and increased siltation. It is hard to envision persistence of this lake from Pliocene times to the recent had current conditions obtained for more than a very small fraction of its history. Comprehensive coring in the current Lake and surrounding area should yield sufficient fossil evidence of both flora and fauna, at least in the Late Pleistocene and Holocene, to allow a detailed environmental history to be established. It should be emphasized that UKL may have persisted in some form for perhaps 20 million years or more, from as early as the Miocene (Yonna

Formation). As such, it is one of the oldest North American lakes and one of the few western US to survive to the present in a relatively intact state. The only other possibly comparable example, California's Eagle Lake, is relatively alkaline and has few surviving mollusks. Other examples relatively intact 150 years ago are now heavily modified and have lost almost or all of their native mollusks: Clear Lake, California; Lower Klamath Lake and Tule Lake, Oregon-California; and Pyramid and Walker lakes, Nevada are the prominent cases in point. The fate of these lakes (and particularly of thier native biota) should serve as cautionary notes to those managing the UKL system.

PREVIOUS WORK

No other detailed mollusk surveys aimed specifically at the Upper Klamath Lake drainage have been conducted prior to this one. However, many malacologists, both professional and amateur, have collected in this area since 1838. Particularly notable are efforts by Hanna, Smith, and others: early records from the area were compiled by Binney (1865) and by Henderson (1929, 1936b). The comprehensive bibliography by Taylor (1975) lists nearly all early efforts. Particularly notable are species descriptions and records of Smith (1975); Hanna (1922); Clench (1940); Berry (1947); and Taylor (1960, 1966b, 1985). Interest continues to this day, *e.g.*, Hershler (1994). Aside from published works, there are a number of unpublished locality records in the gray literature. Examples include sites visited in the 1950s and 1960s by D. W. Taylor (Gregg, unpub.). Additional localities in this area were collected in the 1970s by Clarke (1976 unpub.). Other sites are included in Frest & Johannes (1994c).

In evaluating the results of this survey, it proved useful to compile a list of species previously reported from the area and their reported habitats. Major sources were Henderson (1929, 1936a, b); Taylor (1977, unpub.; 1981; other unpublished notes); and our own previous work dating from 1991-1995. Terminology of the earlier works has been modernized, consistent with that described in **TAXONOMY** below. Results are summarized in Table 1.

METHODS

FIELD COLLECTIONS

Standard methods in malacology were used to implement the study. An initial (baseline) survey of the study area was conducted to evaluate habitat types, possible collection sites, and access. This was initiated in 1991 (before the present project) and continued in 1992-1993. Collection methods varied according to substrate type and degree of aquatic macrophyte or plant and animal epiphytic cover. In general, all areas were visually inspected first and then spot sampled to insure completeness of coverage and size and extent of major subhabitats prior to comprehensive collection. More systematic methods were used for formally defined sites. In coarse substrate areas such as cobble-boulder bars, a random sample of stones was removed along measured transects and the mollusks were either hand collected or brushed from them into a 7.5" X 13" [19.1 x 33.0 cm] tray. Areas with mud, sand, or silt substrate were sampled by excavating small areas of bottom sediment to a depth of about 3 cm using a dip net with an 8" [20.3 cm] diameter and effective mesh size of 40 [Tyler equivalent 35 mesh: openings 0.425 mm]. Areas with rooted aquatic macrophyte vegetation (*e.g.*, shallow portions of deep spring pools and channel edges in slow-moving streams) were also sampled using the same size dip net. Vegetation was retrieved with the net and then placed in 7.5" x 13" [19.1 x 33.0 cm] trays and vigorously shaken to dislodge all mollusks. In areas with bedrock or cobble-boulder substrate (most of the study area), the bedrock or liths were scrubbed underwater with a scrub brush. Dislodged material was caught and retained in a submerged 7.5" X 13" [19.1 x 33.0 cm] tray positioned downstream from the scraped surface. We took at least 10 subsamples from each sample site: the surface area represented at each was generally about 1 m^2. Most of our samples were collected along a 100 ft. (approximately 30 m) transect. Where possible, transects were across the river or other water body; however, some transects were run parallel to shore, particularly where major tributaries joined the chosen body. In small springs, large samples were not feasible, and hand and dipnet collections the chosen methods. Large volumes of specimens were not typical, except from larger springs; these could be treated much as river sites. Where soft substrate (mud-fine gravel was locally significant, samples were collected and sieved separately from the coarse substrate samples in the field (to 40 mesh) to eliminate mud. Generally, a 9-16 oz. [266.2-473.2 ml] volume of sieved concentrate from each such site was saved and labeled separately. Where such samples contained large volumes of substrate (sand-fine gravel) and small numbers of mollusks, mollusk separation and relaxation was not practical, and the sample was preserved immediately. We also include three dredging samples from one-mile transects in deeper portions of Upper Klamath Lake. These were collected by a 16' otter trawl towed behind a 17' Boston Whaler; the collector was David C. Simon (Oregon State University). Regardless of origin, the collected material from each subsample from either coarse or fine substrate was decanted into a labeled 16 oz. [473.2 ml] container for further treatment. The subsamples were run through a standard sieve series (to 40 mesh) in the field to ensure collection of all mollusks and to eliminate very coarse and very fine organic debris, mud, and silt. For samples expected or known to contain difficult to identify species, we routinely employ relaxation, fixation, and preservation using a succession of menthol and propylene phenoxytol, dilute formalin, and either isopropyl or ethyl alcohol (Frest & Johannes, 1992b). While we were equipped for such techniques, they were not necessary for all samples.

Snails were typically not common in Upper Klamath Lake, but they were often abundant in the tributary creeks and springs. Samples frequently contained large volumes of organic material. It was necessary to sieve them upon collection to ensure relaxation and proper preservation. Sieved samples, generally a concentrate with a volume of 9-16 fluid oz. [266.2-473.2 ml], were placed in labeled jars. Each site required an average of 1 hour to collect. We made a special effort to collect drift samples; such samples often provide information as to composition and changes in mollusk faunas, at least dating to the last high-water period (Frest & Johannes, 1993a, c). Such samples were very rare here. The surrounding shoreline of major streams, lakes, and pools was also searched for unionacean mussels, and a representative sample retained. Notes on collection conditions, substrate, habitat, and associated flora and fauna were made at each site (see **APPENDIX A** for description; **APPENDIX B** for site maps).

Initial field work for this project was conducted between June 16 and July 1, 1994. A draft report was issued in 1994 (Frest & Johannes, 1994d). In 1995, additional field work took place in April and in October. Lesser amounts of fieldwork in this area but outside of this contract were done in 1991, 1992, and 1996. For this contract, 1997 fieldwork took place between September 26 and October 10, 1997. Particular areas of interest were springs and other oligotrophic habitats, *i.e.*, those environments especially characteristic of western North America prior to human settlement. However, all major habitat subtypes present in the region were sampled, in order to allow a comprehensive picture of the current state of the regional malacofauna to be generated. A large number of our sites were on public lands (see Table 6), as much of the area is under public ownership (USDA Forest Service; USDI BLM; USDI USFWS, etc.). Still, 1/3 or more of the localities were on private land, as we wished to visit as many significant habitat sites as possible, regardless of ownership. In general, land owner cooperation, be it public or private, was excellent and was greatly appreciated.

1997 fieldwork emphasized placement of more sites in Upper Klamath Lake itself; in the Link River area; and at Barkley Springs. In part, this reflects Bureau of Reclamation interest in these portions of the drainage and their importance to sucker conservation. Also, these areas are local hotbeds of endemism in the Mollusca. We also attempted to systematically fill in areas not done in much detail in previous years. Specifically, we added more sites to the upper portions of the Lost River and to the Sprague River drainages. For detail maps of sites in the Link River area, see **Figure 2** herein; for Barkley Springs and Hagelstein Park, see **Figure 11** herein. Results from these areas will be discussed separately below. As before, for overall site map, see **Figure 1** and for detailed maps of individual sites, see also **APPENDIX B**. New features in this report include keys to certain species (**APPENDIX C**) and distribution maps for selected taxa (**APPENDIX D**). Distribution maps for some of the more Sensitive Link River and Hagelstein Park taxa constitute **Figures 3-10** and **11-23**.

LABORATORY PROCEDURES

Preserved samples were resieved in the laboratory to remove fine sediment and plant and animal detritus, and the full volume was examined. The whole sample was picked for mollusks under a low-power binocular microscope. With many mollusk taxa (especially certain Physidae and Hydrobiidae), dissection, particularly of relaxed specimens, is necessary for proper identification. Of the species of special interest to this study, this can apply to the Pleuroceridae, Physidae, and Hydrobiidae. It is particularly significant here, as a number of new and previously described species, especially in the difficult hydrobiid genera *Fluminicola*, *Pyrgulopsis*, and *Lyogyrus*, were encountered. Dissections and drawings of selected specimens were done using standard methods under a Wild M3 microscope equipped with a drawing tube. Picked mollusks and other invertebrates have been retained for further study. The mollusks were placed in buffered 70% ethyl or isopropyl alcohol-15% glycerin-15% water to ensure fixation and intact long-term preservation. Alcohol-resistant paper and ink is used for preparation of permanent labels. Field and other information has been entered in a data base devoted to mollusk collection management (Deixis MolluscDB™).

TAXONOMY

The need for species-level identifications precluded the use of standard textbooks (*e.g.*, Pennak, 1989; Thorp & Covich, 1991). Very few of the common species found here are mentioned in Pennak (1989), and none of the most significant taxa. However, species-level manuals have long been available for many North American freshwater forms. Where possible, the standard references (Burch, 1989 or its two predecessors Burch & Tottenham, 1980-Burch, 1982b-Burch, 1988 and Burch, 1982a for gastropods; Burch, 1972, 1975a and Clarke, 1973, 1981 for sphaeriids: Burch, 1973, 1975b for unionacean bivalves) were used. For undescribed taxa and recent changes in nomenclature, reference was made to the periodical and gray literature (*e.g.* Taylor, 1981). For *Fluminicola*, extensive use was made of Hershler & Frest (1996). We also employed our own rather extensive reference collections. We have also examined large numbers of specimens of some taxa in the major US museums (see **MUSEUM COLLECTIONS**). Common names, and species endings, are generally those of Turgeon *et al.* (1988) where possible. Higher taxonomic arrangement is largely that of Vaught (1989), except for that for the Sphaeriidae, which follows McMahon (*in* Thorp & Covich, 1991) and for the Hydrobiidae. For limitations of the Vaught classification see Frest & Johannes (1995a).

In most cases, we use the species definitions and ranges of Taylor (especially Taylor, 1981) in preference to those cited in other sources for certain western North American forms. Our reasoning is as follows. Until his recent retirement (*pers comm.*, P. Bowler, 1991), Dwight Taylor had perhaps the most comprehensive knowledge of western North American freshwater mollusks of any one living. He collected, described, and published upon freshwater fossil and modern forms from Oregon, California, and adjacent states from the 1950's through 1988. His bibliography (Taylor, 1975) remains the standard reference for western North America. Freshwater mollusks have been collected extensively in Oregon, beginning with the pioneer work of J. G. Newberry and T. Nuttall. In the late nineteenth and early twentieth centuries, major collectors were H. Hemphill, H. Hannibal, and J. Henderson. Particularly important early to late twentieth century workers were S. S. Berry, G. D. Hanna, W. O. Gregg, E. P. Chace, and Taylor. Taylor worked closely with some of these investigators, including Berry and Gregg. In the course of his own extensive researches, he reexamined the types of essentially all western North American forms, among others. Comparatively recently, he reviewed the literature on, and summarized the status and distribution of, the described California freshwater forms (Taylor, 1981).

In order to facilitate comparison of species concepts, particularly between Taylor (1981) and Burch (1989), our use of certain names is discussed here. Moreover, a few nomenclatorial changes have been included to reflect work done by various workers since 1982 (the effective end of literature coverage in Burch, 1989 and Taylor, 1981):

1) We use *Pyrgulopsis* as defined in Hershler & Thompson (1987) and Hershler (1994) in preference to *Fontelicella* and the other taxa described by Gregg & Taylor (1965). In the long run, subdivision of *Pyrgulopsis* will undoubtedly prove useful, perhaps along the lines of Gregg & Taylor (1965). However, many species have been added to the genus (*s.l.*) in the last five years, particularly by Hershler (*op. cit.*); and many more remain to be described.

2) *Lyogyrus* has recently been raised to generic status by Hershler & Thompson (1991). Note that, as discussed above, we believe that western amnicolinids actually represent an undescribed genus only superficially resembling *Lyogyrus*.

3) Taylor (1966a, 1985) uses the name *Lithoglyphus* in preference to *Fluminicola*. However, Thompson (1984) provided data that indicate the distinctness of the European and

American forms ascribed to *Lithoglyphus*. Additional unpublished information strengthens this interpretation; and this genus is currently being revised (Hershler, 1994; Hershler & Frest, 1996).

4) We follow the lymnaeid generic classification of Burch (1989) for *Stagnicola* and for *Fossaria*, but the species taxonomy of Taylor (1981). We follow Taylor (1981) and Vaught (1989) in regarding the Lancidae as a distinct family.

5) We follow the practice of Taylor (1981) in regard to *Menetus*. Taylor (1981, p. 160) believes that the two commonly used names, *cooperi* and *opercularis*, are misapplied. Specimens here placed in *M. callioglyptus* (Vanatta, 1895) would be regarded by Burch (1989) as *M. opercularis* (Gould, 1847), a species that Taylor believes was restricted to Mountain Lake and is now extinct. The most comprehensive review of *Menetus* is in Baker (1945).

6) Taylor (1981) uses the species name *californica* (Rowell, 1863) for forms of *Ferrissia* that would be included in *F. fragilis* (Tryon, 1863) by Burch (1989).

7) Pending further investigation, we follow the classification of Taylor (1981) in regard to the Physidae, recognizing relatively few species in Oregon.

8) We use *Anodonta californiensis* Lea, 1852 in preference to *A. nuttalliana* Lea, 1838 for some California winged *Anodonta*; others are *A. wahlametensis* Lea, 1838, as recognized by Taylor (1981).

9) The classification of the Sphaeriidae (=Pisidiidae of Vaught, 1989) largely follows McMahon (in Thorp & Covich, 1991). However, Taylor (1981) preferred the use of *Musculium raymondi* (Cooper, 1890) for specimens elsewhere called *M. lacustre* (Müller, 1774). Taylor (1981) uses the specific name *Musculium truncatum* (Gould, 1845): in other works, this species is referred to as *M. partumeium* (Say, 1822). Taylor (1981) preferred to retain *Pisidium contortum* Prime, 1854 and *Pisidium pauperculum* Sterki, 1896 as full species, rather than as subspecies or forms of *P. nitidum* Jenyns, 1832, as done by Clarke (1973, 1981) and others. Other minor nomenclatorial preferences are noted in the species discussions.

10) For undescribed taxa, we use a regional system first employed in Frest & Johannes (1995a) and being upgraded in Frest & Johannes (1998, in press). The idea here is to provide consistent names for these taxa across western North America.

11) In order to aid in identification of local forms, many of which are undescribed, we here reproduce portions of a set of keys developed originally for Frest & Johannes (1995a) and revised and upgraded in Frest & Johannes (1998, in press). These constitute **APPENDIX C.** Only the general freshwater key and those most relevant to the UKL region are included here. For more complete treatment, including terrestrial forms, see Frest & Johannes (1998, in press).

MUSEUM COLLECTIONS

Many records for freshwater mollusk species are unpublished data resident in the major US natural history museums. Moreover, older published species citations, particularly for small forms such as Hydrobiidae and difficult groups such as the Physidae, vary in accuracy from worker to worker and are frequently wrong, as are some museum identifications. To confirm presence, identity, and collection date, it is necessary to rely heavily upon museum collections. A major advantage of employment of the taxonomy of Taylor (1981) is that he used museum collections extensively, as well as making many others himself; consistent identifications and methodology, and a high level of accuracy, in his work may be presumed. In the course of other research, we had compiled museum records for several Upper Klamath streams and examined specimens of many others. Particular emphasis was placed upon inspection of types, as published illustrations and descriptions, especially in older literature, cannot be assumed to be accurate. We have also recollected many species from their type localities (*i.e.* obtained topotype specimens), where such sites are still extant. In 1991, before this project began, we visited the following institutions, all known to have extensive western US freshwater mollusk collections: Academy of Natural Sciences of Philadelphia (ANSP); California Academy of Sciences (CAS); Delaware Museum of Natural History (DMNH); National Museum of Natural History (Smithsonian Institution) (NMNH); University of Michigan Museum of Zoology (UMMZ); University of Colorado Museum of Zoology (UCM). Some additional collection information was gathered in 1995 (Frest & Johannes, 1996A). This effort will be expanded to other species and institutions if possible.

Some early results are summarized in Table 5.

RESULTS

OVERVIEW

To date we have surveyed approximately 296 freshwater sites in the Upper Klamath drainage (**APPENDIX A**). About 125 had mollusks (Tables 3, 4); about 120 have endemics or Species of Special Concern. Hydrobiids were noted at approximately 130 sites. Perhaps 60 have small *Fluminicola*; 80 large *Fluminicola*; 25 *Pyrgulopsis*; and 24 *Lyogyrus*. Seventeen sites have *Carinifex*; 26 have *Lanx*; 9 sites have *Juga*. As regards bivalves, *Anodonta californiensis* remains rare (1 site), as do larger bivalves generally; 6 sites have *Pisidium ultramontanum*; and 3 have *Pisidium* n. sp. 1. Since our last report, we added over 100 sites: 80 additional with mollusks;

doubled the number of hydrobiid sites; added 10 small *Fluminicola* sites; added 45 large *Fluminicola* sites; 15 sites for *Pyrgulopsis*; 9 for *Lyogyrus*; 9 for *Carinifex*; 13 for *Lanx*; two for *Juga*; 1 for *Pisidium (C.) ultramontanum*; and 1 for *Pisidium* n. sp. 1. Note that the considerable addition of new sites for significant species implies that even more survey work should be done. We continue, for example, to find new forms or forms that have not previously been noted from Oregon. This year, for example, we added two new species and found a site for *Physa (Physa) skinneri*, not previously reported from Oregon (see Taylor, 1988, for comprehensive review of known sites for this taxon). We also added a number of species to the Upper Klamath Lake drainage faunal list, such as *Gyraulus (Armiger) crista*, known from only about three sites in the state.

Occurrence of several Species of Special Concern (Sensitive Species in the usage of Frest & Johannes, 1995b, 1998, in press), quite often a mix of gastropods and bivalves, at particular sites is typical. Certain areas are of special interest, especially the large spring complexes on both sides of Upper Klamath Lake, at Bonanza, and along the lower Williamson River. Duncan Springs is also notable. So are Tecumseh Spring; Kimball State Park; Collier Park; Reservation Spring; and Agency Spring. Perhaps most notable is Hagelstein Park, treated separately below. Areas of especial importance in Upper Klamath Lake itself are the Link River area (also treated separately below); Rattlesnake Point; and the submerged springs at Ouxy Springs; Sucker Spring; and near Modoc Point. On the northwestern side of the Lake, the most significant areas are Harriman Springs; Malone Springs; Odessa Creek; the springs along Short Creek; Crystal Spring; and the series of springs between Blue Spring and Jacks Spring, including Mare's Egg Spring and Tiger Lily Spring. Note that many of these springs are also significant as spawning or other habitat for the drainage's endemic suckers (Lost River, Shortnose; Klamath largescale). Caution must be taken to avoid causing extinction of endemic mollusks to save endangered suckers; but it should be realized that measures supportive of the ecosystem as a whole should benefit both.

Endemics may occur in all of the major river systems, including the Sprague and Lost rivers. Much of the drainage basin of these two rivers is now unsuitable habitat for endemic mollusks, as is the upper Williamson. The northern portion of the Upper Klamath Lake Basin, including Klamath Marsh, may also be unsuitable due to the heavy pumice falls associated with Crater Lake's Mazama event. The middle Klamath system fauna remains largely unique and narrowly endemic, only partly related to that above the Link River.

A number of new taxa (at least 18 to date) were discovered here during field work conducted in 1991-1997. Many of these species appear to occur only in this area, *i.e.* are narrow endemics. Others may be restricted to the middle Klamath drainage. This degree of endemism is extraordinary. It may be ascribed to the pivotal position of Upper Klamath Lake and its comparative great age. The current fauna is a mix of coastal and Great Basin elements, with a few Great Basin periphery endemics as well. The continuance of this lake for a longer period than typical of Great Basin pluvial lakes may also have allowed local speciation. Upper Klamath Lake is one of the few surviving Pliocene lakes and the only one with normal alkalinity and a large relict fauna. It is likely the best remaining window on environments prevalent in the interior West 2-17 million years ago. Suggested former drainage connections with the Snake system and with the Sacramento system also have enhanced species diversity. The area may also have been a part of a former, short-lived connection to the Columbia system.

Endemism occurs in several freshwater snail genera. Notable are the hydrobiid genera *Fluminicola* (at least 12 new species), *Lyogyrus* (at least 3 new species), and *Pyrgulopsis* (at least 2 new species, plus *Pyrgulopsis archimedis).* Upper Klamath Lake has the only surviving lake *Pyrgulopsis* species; but its peripheral position to the Great Basin means that the high diversity and high rate of endemism in *Pyrgulopsis* characteristic of core Great Basin areas is not as prominent here. Instead, spring and small stream environments are occupied by a number of apparently endemic *Fluminicola* and *Lyogyrus* species with similar habitat requirements. Endemism also occurs in the aberrant pulmonate genera *Vorticifex* and *Lanx*, both of which have species adapted to pluvial lakes, and in the unusual planorbid genus *Carinifex*. Most of the endemic taxa are stenotopes, requiring clear, well-oxygenated conditions with some flow; most are stenothermal as well.

Some 73 mollusk taxa have formerly and (including the 18 new species) are now ascribed to the Upper Klamath drainage (Tables 1, 2). We have seen live specimens of 70, including 67 native taxa; some 4 species are introduced, of which we have located 3. Natives collected alive so far include roughly 47 freshwater snails and 20 freshwater bivalves. To date, we have not collected 3 described freshwater snails and 3 described bivalve species believed to have once occurred in the area, while we have added a substantial number of new taxa. Definite literature reports are somewhat difficult to interpret, due to changing taxonomy, but we suspect that about 30 gastropods and 15 bivalves were previously in museum collections. Of the 296 sites written up formally so far, 207 had freshwater mollusks, a respectable showing considering the degree of recent habitat change, and comparable to that observed elsewhere (*e.g.*, Frest & Johannes, 1994a). Diversity at those sites with freshwater taxa averages between 3 and 4 species, about what would be expected from a semiarid area with spring environments predominant. A few sites have diversities comparable to those of the exceptional Upper Sacramento system nasmodes, and are comparable in their exceptional quality and endemic diversity as well. Previous treatments (Frest & Johannes, 1993b; ROD, 1994; USFWS, 1994; Frest & Johannes,1995a, d) of the mollusks of this area have recognized some 31 species [20 freshwater gastropods; 7 freshwater bivalves; and 4 terrestrial gastropods] as Sensitive or in need of protection (Table 2). Frest &

Johannes (1993b) gave special status to 18 taxa; 5 of these are ROD species; and 29 were covered in the Interior Columbia Basin report (Frest & Johannes, 1995a). None of these taxa are as yet federally listed, although 2 bivalve species are current C2 candidates. Frest & Johannes (1998, in press) add several additional Sensitive terrestrial and a few additional freshwater taxa to this region.

Past and ongoing modifications of the Upper Klamath system, including dredging and/or diversion of peripheral spring and stream channels, manipulation of water levels, siltation, and nutrient enhancement have very drastically reduced habitat for most of the endemic taxa. Many survive only at spring sources or in spring-influenced areas. We find that many of the comments made in the literature in regard to fishes apply equally to mollusks. One example will be cited here (Scoppettone & Vinyard, 1988, p. 368):

> *Upper Klamath Lake and its watershed have been greatly affected by agriculture, and water use has reduced volume and changed flow patterns into the lake. Chiloquin Dam, constructed in 1928, blocks upstream migration and precludes accumulation of suitable spawning gravels below the dam. Open Diversions and pump stations may entrain larvae in their downstream migration, and the lake itself has been markedly altered. In 1912 Link Dam (2.5 m high) was constructed across the outlet of Upper Klamath Lake, and the system has since been operated as an irrigation reservoir. Since construction, sedimentation has greatly increased, nutrient loading has risen through return of agricultural water (US Army Corps of Engineers, 1979), and available spawning habitat has been markedly reduced. ......General alteration and destruction of habitats in upper parts of the system must also have had an impact. "*

Many of the same impacts also affect mollusks. Many species, including common ones, are now limited to very small areas with relatively unaffected groundwater flow. In Upper Klamath Lake itself, for example, many of the lake endemics and other rare and Sensitive taxa live only in or in the immediate vicinity of submerged springs, in very limited areas of the lake bottom. Attempts at dredging indicate that only a few taxa, only one of which is Sensitive, occur in wide areas of the lake bottom. Restricted are such taxa as the UKL drainage endemic *Pyrgulopsis archimedis*, lake populations of the UKL endemics *Pyrgulopsis* n. sp. 1; *Vorticifex klamathensis klamathensis*; and *Vorticifex effusus dalli*; the regional endemics *Pisidium ultramontanum* and lake populations of *Pisidium (C.)* n. sp. 1; and lake populations of the strict UKL endemic *Lyogyrus* n. sp. 4. Many of the other endemic species are similarly limited, some to single springs (*Fluminicola* n. sp. 2; *Fluminicola* n. sp. 3; *Fluminicola* n. sp. 16; *Fluminicola* n. sp. 30). many others have very limited distributions, such as *Fluminicola* n. sp. 29; *Lyogyrus* n. sp. 3; *Lyogyrus* n. sp. 4; and *Lyogyrus* n. sp. 5. For maps of the distribution of these taxa. see **APPENDIX D**; in some cases, more detailed maps are available, *e.g.*, for the Link River area (**Figures 2-10**) and Hagelstein Park area (**Figures 12-20**). it is a safe generalization that many taxa in the UKL drainage are now dependent upon good groundwater quality for survival. Unfortunately, continuing agricultural and other impacts will eventually work their way into this system, as they are beginning to now in the middle Snake River area, Idaho, unless measures are taken. In any case, reduction of many species to remnant, isolated populations is reason for concem. Some other examples are worth noting here. *Lyogyrus* n. sp. 3 now survives only in the Link River in narrow area (**Figure 6**) and in spring-influenced areas of the Williamson and Sprague rivers (**APPENDIX D**, Map D9). *Pyrgulopsis* n. sp. 2 survives only in spring-influenced areas in the Lost and Sprague rivers (**APPENDIX D**, Map D10). *Helisoma (Carinifex) newberryi newberryi*, another Sensitive species, was formerly reported from the Sprague (Taylor, unpub. museum records); but now occurs only in and immediately around Upper Klamath Lake and the large Williamson River springs (**APPENDIX D**, Map D6). Note also that many of the new taxa live only or mostly in springs. Examples include *Juga (Oreobasis) "nigrina"*, all of the small *Fluminicola* species [about 9], *Lyogyrus* n. sp. 5, *Pyrgulopsis* n. sp. 1, *Vorticifex effusus diagonalis*, and *Vorticifex klamathensis sinitsini*. It is further worth noting that many UKL drainage taxa do not occur throughout the current drainage; but instead are limited to portions of it. Often, sets of springs are involved. For examples, see **APPENDIX D**, Maps D2-5, D9.

Large numbers of springs are either now dry, converted to cattle troughs, otherwise diverted or "managed", or heavily grazed. Such sites lack interesting mollusk faunas. Even so, our original estimate of the number of endemics (Frest & Johannes, 1995d; Table 1 here) is likely to prove conservative. While this is beyond the scope of our present contract, it should be noted that there also appear to be at least a few endemic land snail taxa in the area, though not so many as in the lower Klamath River drainage (Roth, 1993; Frest & Johannes, 1993b, 1995a). These include undescribed *Monadenia* species; a *Vespericola* related to *V. sierranus*, another SOSC aand ROD taxon; the Klamath tail-dropper, an undescribed *Prophysaon* species (see Frest & Johannes, 1998, in press); *Pristiloma arcticum? crateris*, a ROD taxon; and likely other ROD taxa, such as *Prophysaon dubium* and *Prophysaon coeruleum*.

In the future, we intend to further explore the periphery of the Upper Klamath Lake drainage, especially the border with the Oregon Interior Province and the middle Klamath River portion. Preliminary indications are that we have in excess of 14 new *Fluminicola*; 3 *Lyogyrus*; and possibly 3 *Pyrgulopsis* species. Additional novelties in *Lanx* and *Vorticifex* are probable also. Other highlights of the area include the best remaining populations of the large unionids *Margaritifera falcata* and *Gonidea angulata* in the state (these in the lower Williamson River); the sizable number of relatively undamaged large cold spring complexes; and the occurrence at a few sites of the so-called mares eggs (gigantic *Nostoc* colonies), which we have seen nowhere else in the west.

LINK RIVER

To date, we have collected mollusks at about 16 sites in the Link River area. Sites are concentrated in the regions above the Link River Dam and then toward the south end of the river, above the outfall from the Keno Canal and also near the junction with Lake Ewauna. This reflects actual mollusk distributions. The areas below the Link River Dam are scoured regularly by major water and flow fluctuations due to regulation and lack mollusks for some distance. Similarly, live mollusks are absent from the Keno Canal itself. Lake Ewauna is more complex. This area probably once was excellent mollusk habitat: but due to log fleeting and location of outfalls from a lumber mill, there are only a few, rather cosmopolitan mollusk species found in most areas. The lake improves considerably at the junction with the Link River and declines very rapidly downstream.

The Link River (**Figure 2**), even while greatly impacted by pollution from Klamath Falls and in Lake Ewauna, not to mention from flow regulation at Link River Dam, still maintains some of the best mollusk habitat in the region. Such habitat is extremely local and patchy, however, and subject to degradation or change if pollution increases or if the regulation regime is changed. At present, the area above Link River Dam is mostly pretty degraded habitat due to impoundment and pollution: however, there are local patches of three Sensitive species, *Fluminicola* n. sp. 1 (**Figure 3**), *Vorticifex effusus dalli* (**Figure 9**), and *Vorticifex klamathensis klamathensis* (**Figure 10**). Note that the latter is the only one really successful in this area. More significant from the point of view of mollusk conservation is the area north of the Keno Canal outfall. Here, there are very significant populations of the following taxa: *Juga (Oreobasis) "nigrina"*, including all but one or two of the drainage's populations; *Lanx klamathensis* (one of the best known sites); *Lyogyrus* n. sp. 3 (the second largest known population); *Pyrgulopsis archimedis* (probably includes the type population); *Pyrgulopsis* n. sp. 1 (almost all known populations); *Vorticifex effusus dalli* (the best remaining population); and *Vorticifex klamathensis klamathensis*) (a large population) (**Figures 4-10**), Note that, of the Sensitive species occurring in this area, only *Fluminicola* n. sp. 1 does not occur in this reach (**Figure 3**). For a short stretch downstream of the outfall, mollusk populations are sparse; but things pick up appreciably near the terminus of Link River and immediately below, despite urbanization. In this area are found large populations of *Lyogyrus* n. sp. 3 (the largest known); *Fluminicola* n. sp. 1; *Vorticifex klamathensis klamathensis*; and *Lanx klamathensis* (one of the top two or three known sites); plus smaller populations of *Pyrgulopsis archimedis* and

Vorticifex effusus dalli. Only *Juga (Oreobasis) "nigrina"* and *Pyrgulopsis* n. sp. 1 of the local Sensitive species are missing here (**Figures 3-10**).

Part of the reason for survival and maintenance of these stretches is the prevalence of spring drainage and input specifically in these areas. The Link River springs (about 6) on the SW side just above the Keno Canal outfall are the only reason for survival of *Juga* and of *Pyrgulopsis* n. sp. 1; they are probably vital to the survival of the more strictly riverine species in the adjoining stretch of the Link River as well. The spring influence in the other stretches is less obvious but can be observed in two ways: one, when the Link River is very low: areas with spring inflow show as clear and much colder than surrounding waters, even when subaqueous. Second, direct physical measurement with a temperature probe can locate precise boundaries of subaqueous spring influx when water is high or low. Maintenance of good ground water quality and of continued undisturbed flow of these springs is quite significant to mollusk conservation in this area. Reduction of sediment and nutrient loading and stabilization of the flow regime would predictably enhance mollusk populations in other parts of the Link River system. For precise delineation of spring affected areas here, overlap of the Sensitive species maps provides significant data.

HAGELSTEIN PARK

To date, we have about 26 formally defined sites in the Hagelstein Park area, including sites in the west channel, south channel, adjoining Upper Klamath Lake, the irrigation ditch to the south of the Park, and the north springs and Barkley Spring areas (**Figure 11**). This is a complex area with a complex history; we will deal here largely with its present state. We provide detailed maps of the known and inferred distribution of about 12 Sensitive mollusk species in this area (**Figures 12-23**). Major subhabitats are the source spring areas, mostly in the extreme NE part of the Park and at Barkley Spring itself and some adjoining spring influenced areas, such as the head of the irrigation ditch (although almost destroyed) and near localities 128 and 129. However, there is some spring influence along the whole of the east side of the Park, with the likely exception of sites 97 and 197. A second major subhabitat includes areas with stable rocky substrate and good flow, especially sites 98, 99 (in part), 202 (in part), 204, 7, and 128; 201 also fits partly into this category; but recent manipulation to promote fish recovery has degraded this area, perhaps temporarily, as mollusk habitat. This area formerly had abundant *Lanx klamathensis*, *Fluminicola* n. sp. 27, and *Lyogyrus*; but our last revisit in 1997 indicated that these were reduced almost to extinction, although quantities of dead shells were noted. The next subhabitat embraces area with good water quality and relatively oxygenated soft substrate, such as much of the central and south portions of the north springs area (sites 204, 205, 195, 196, 206, 198, and 199) as well as parts of the south channel and west channel (sites 192, 193, 200). Finally, areas with soft substrate, slow flow, and local hypoxia include sites 191, 209, 97, 297, and 208. In all cases, areas immediately adjoining these sites have similar habitat, at least until another site is approached.

Species distribution of even Sensitive taxa varies considerably. Note that *Fluminicola* n. sp. 1 is not present at lake site 289 but does occupy 129 and penetrates a significant distance into the west channel, even overlapping with *Fluminicola* n. sp. 27 in a limited area (**Figures 12, 13**). This latter species, a spring endemic, is the most ubiquitous in the Hagelstein Park area, being successful everywhere except in the most degraded areas or when the lake itself is approached. Very successful in soft substrate, well-oxygenated areas is the unusual *pulmonate Helisoma (Carinifex) newberryi newberryi* (**Figure 14**). This taxon, however, does not persist into the lake (it does so quite successfully elsewhere) or far into the central part of the west channel, an area of slow flow and mostly mud substrate. It also avoids spring sources, especially with coarse substrate. The Hagelstein Park sites collectively are the largest single site for this species in the UKL drainage; it is abundant and varies considerably locally in morphology. *Lanx klamathensis*, also partly a lake endemic, is less successful in the lake sites and west channel; but significant populations occur in rocky areas near the spring sources (**Figure 15**). This is one of the larger of the spring occurrences for this species; and only a handful of populations are known for this UKL drainage endemic.

Lyogyrus n. sp. 4 (**Figure 16**), another UKL drainage endemic, occurs only on rocky substrate near spring sources in this area. Hagelstein has the only known spring occurrences of this taxon. As noted in the discussion of "*Lyogyrus*", this taxon belongs to an undescribed genus. Moreover, there is a strong possibility that the Ouxy Springs populations represent a separate taxon. There are only two lake populations with the Hagelstein morphology, both in submerged springs near Modoc Point. The UKL lake endemic *Pyrgulopsis archimedis* occurs at site 19 and invades the west channel only in the swift-flow, spring-influenced site 128 and one other (**Figure 17**). The specimens here are the largest known; and this is perhaps the best remaining population. *Vorticifex klamathensis klamathensis*, largely a lake endemic and found only in the UKL drainage, has a similar distribution to the last species: it is unable to penetrate beyond the central part of the west channel (**Figure 18**). Note that the southern lake site lacks this species. *Vorticifex klamathensis sinitsini* is a strict spring endemic originally described from Barkley Spring. It is found currently in Hagelstein Park through most of the north springs area and in higher quality habitat in the south channel (**Figure 19**). Note absence from essentially all of the west channel. Most known sites are still in Hagelstein; but we have located a few possible sites in springs on the NE side of Upper Klamath Lake (see **APPENDIX D**, Map D13).

Turning now to bivalves, the large unionid *Anodonta oregonensis* has a very limited distribution here, essentially only in the neck of the west channel, just before its terminus in Upper Klamath Lake (**Figure 20**). This taxon is of rare occurrence elsewhere in the drainage (**APPENDIX D**, Map D14). The small Modoc Plateau peaclam, *Pisidium (C.)* n. sp. 1, is known from less than half a dozen sites in two areas, the Upper Klamath Lake drainage and the Modoc Plateau portion of the Sacramento drainage. The only occurrences here are situated almost identically to those for *Anodonta oregonensis*. Note that only three sites are known in the UKL drainage (**APPENDIX D**, Map D15). The distribution of the one-time candidate taxon *Pisidium (C.) ultramontanum* here is exactly the same (**Figure 22**). This taxon is known from less than 10 surviving sites, as with the last in the UKL and upper Sacramento drainages. Oddly, this taxon is absent from most of the large UKL nasmodes, while it occurs in such in the Upper Sacramento drainage. There are historic river occurrences in the middle Klamath and the Pit; but so far none in this region, perhaps due to the general degradation of local riverine habitat. One final fingernail clam taxon deserves mention here. *Pisidium (Pisidium) idahoense* is not a strict western endemic like the other taxa mentioned, but occurs in parts of western Europe and the Russian federation as well. However, sites on a world-wide basis are quite scarce. Most are in the western US, with less than 40 confirmed to survive. This species occurs extensively at Hagelstein, in silty substrate in habitat classed as excellent to (more typically) slightly degraded (**Figure 23**). There is a concentration of occurrences in the UKL drainage unprecedented elsewhere.

UPPER KLAMATH LAKE

As of this writing, we have approximately 20 sites in Upper Klamath Lake itself. Most of these are in relatively shallow water; but three represent one-mile trawls in deep water in various parts of the Lake (**Figure 1**). As yet, we have relatively few sites on the west side, in part due to access problems. Sites on the north and east tend to concentrate in area with subaqueous springs, in part because of exceptional collecting conditions early on in this project. However, we recently made special efforts to add additional more typical sites. The deep water sites are interesting in that they yielded so few taxa. Only three, *Helisoma (Carinifex) newberryi newberryi*, *Fluminicola* n. sp. 1, and *Planorbella (Pierosoma) subcrenata* were encountered, the former two abundantly. Note that these two are Sensitive species. Many sites had only dead mollusks. In general, mollusks in the shallow areas occur commonly around marshes; but there is a very limited, generalist fauna at such sites, including *Planorbella*, *Valvata humeralis*, *Stagnicola*, *Lymnaea*, *Gyraulus*, *Physella*, and similar taxa. Note that essentially none of the Sensitive or endemic taxa occur at such sites. Areas with Sensitive taxa tend to be places with influx from major spring-fed tributaries, such as Odessa Creek, Malone Springs, Crooked Creek, and the Williamson River; or areas with subaqueous springs. In such areas, such endemics as *Lyogyrus* n. sp. 4; *Lanx klamathensis*; *Pyrgulopsis archimedis*; *Pisidium (C.) ultramontanum*; and *Vorticifex effusus dalli* can be found. Most of these taxa prefer areas with gravel to cobble substrate. Such endemics as *Vorticifex klamathensis klamthensis* and *Fluminicola* n. sp. 1 in habit these areas; but also can survive on soft substrata, if never massively affected by hypoxia or anoxia. Aside from such lithophile taxa, there are a few pelophiles, such as *Valvata humeralis* and *Helisoma (Carinifex) newberryi newberryi*, that are sensitive and uncommon to very rare regionally.

Compared with some ancient lakes (see reviews by Boss, 1978 and Davis, 1979), Upper Klamath Lake has relatively few strict endemics (Table 7). However, there are more surviving here than in any other extant US lake. The drainage as a whole has a very high degree of endemism, with most species spring endemics, but some also river or lake endemics only. Taken as a whole, the UKL drainage fauna is unique; and perhaps the best surviving example of the sort of pluvial lake malacofauna that has dominated the western US for nearly all of the last 20 million years, only to barely survive into the present.

Of the 29 presently recognized endemics, 22 are strictly confined to the Upper Klamath Lake drainage (Table 7). Ten of the 29 occur in Upper Klamath Lake itself, so that the majority of endemics do not. Looking more closely at the 22 strict endemics (precinctives in some biogeographers' terminology), note that only 6 occur in Upper Klamath Lake and none occur only there (Table 8). There is some difficulty conceptually in defining an ancient lake, as water fluctuations and history enter very strongly into the definition. In the past, the lake may have been much larger, and its basin as geologically established may be the best criterion. There are other complications here. Link River is not a regular outlet in the strict sense; and there is some reason to believe that the current connection to the Klamath River is of relatively recent vintage. If so, then Link River should perhaps be considered in the system also. Adding this unit, though, still indicates only 2 strict lake endemics (Table 8). For historical reasons, it is perhaps most useful to include adjacent large and small springs in the lake (*s.l.*), rather than consider them as tributaries. If so, then the number of lake endemics rises to perhaps 8 (Table 8): still a small proportion of the drainage's 22. This would imply either that endemism resulted from a very early stage in the lake's history or that endemism in the tributaries is at least or more important to regional mollusk diversity than is the Lake alone. The latter seems most probable, as adjoining high areas, such as Modoc Rim and Lake of the Woods likely predate the lake's formation. Thus, tributary endemism is unusually important to mollusk biodiversity in the case of this particular and seemingly atypical ancient lake drainage.

Another approach to analysis of local high mollusk biodiversity is to examine habitat restrictions of the 22 drainage endemics. This is done in Table 9, which subdivides aquatic habitats into nine categories. Certain other habitats, such as temporary pools and ponds, marshes, and creeks, have not been included because there are no strict endemics harbored in them here (as is often the case elsewhere for mollusks as well). Note that certain categories which are high elsewhere in the world (*e.g.*, Boss, 1978; Davis, 1979; Taylor, 1988) are low here. Specifically, there are no generally distributed ancient lake species; no river lake endemics; and no strict river endemics. Instead, it is the addition of or combination with spring habitats which inflates endemism. The largest categories involve spring source or spring run species, many of which occur only in either or both. The ancient lake and river lake (here, the Link River specifically) categories become quite significant when spring influence, often subaqueous, is a part of the picture. Next in raw significance is spring ponds (limnocrenes). Even river endemism is enhanced by spring influence. The often-emphasized hypereutrophic state of Upper Klamath Lake and the agriculture-induced nutrient enrichment of local rivers may have exaggerated the importance of springs to this drainage as mollusk refugia and habitat enhancers. Nevertheless, the same tendency has been noted throughout western North America (*e.g.*, Frest & Johannes, 1995b: Upper Sacramento drainage). In the Great Basin, most endemic freshwater species, often *Pyrgulopsis* or *Tryonia*, also occur in springs, and there are relatively few amniphile species (Hershler, 1994; 1998; Frest & Johannes, 1998, in press). There are obligate amniphile mollusk taxa in western North America; moreover, there are a few large-river specialists; however, springs and headwaters, while individually not diverse, are collectively the largest contributors to mollusk biodiversity in the western US, in contrast to rivers and/or ancient lakes, which are clearly major contributors elsewhere, including the central and eastern US (Frest & Johannes,1998, in press). In this sense, the Upper Klamath Lake drainage, even in its current state, is quite a typical example.

SENSITIVE SPECIES

In order to aid in appraisal of the mollusk fauna and its conservation needs, individual species discussions are here provided for the more sensitive species. The final report will incorporate information on all taxa. The format is that of Frest & Johannes (1993b, 1995a, d, 1996a); site- and area-specific information will be provided in the final report. Note that faunal lists in the earlier two versions have been revised, corrected, and updated to some extent (Tables 3-4); it is thus more prudent to rely on locations given in this report. Keys to most of the Sensitive aquatic taxa of the region, and to other taxa that could be mistaken for them, have also been incorporated in this report (**APPENDIX C**). Note that earlier versions of these keys have been updated to reflect more recent information, rendering older versions obsolete. We have also prepared maps of the more Sensitive taxa (**APPENDIX D**). The final report will include maps for all taxa. Information for terrestrial taxa, which were strictly speaking outside of the contract scope, is thus necessarily incomplete. See Frest & Johannes (1998, in press) for further data.

FRESHWATER SNAILS

***Fluminicola* n. sp. 1 Klamath pebblesnail**

Figures 3, 12; Map D2

Type locality: None, as the species has yet to be described.

Description: See final report for description. The tall subglobose conch, dark tentacles and eye patches but light body; and sickle-shaped, moderately large penis are distinctive features. This is a large (*i.e.*, > 6 mm height) *Fluminicola* species with yellow to yellowish brown periostracum. This taxon was cited as *Fluminicola* n. sp. 1 in Frest & Johannes (1993b, 1995a, d, 1996a, b).

Ecology: This species occurs in Upper Klamath Lake, a few major tributaries, and part of the Klamath River, generally in areas with gravel-boulder substrate, spring influx, and some flow. This species, like most *Fluminicola*, prefers clear, cold, oligotrophic flowing water with high DO. It is found only rarely in springs and avoids areas with dense macrophyte beds. It sometimes occurs with other endemic *Fluminicola* spp., *Lanx alta* or *Lanx klamathensis*, *Lyogyrus* spp., *Helisoma (Carinifex) newberryi*, or *Pisidium ultramontanum*. Predominantly a perilithon grazer and lithophile.

There is some possibility that the lower Klamath River populations represent a different taxon, making this species an Upper Klamath Lake endemic found only in the lake proper and in lake-like areas, such as Link River (Table 7).

Original distribution: Klamath River, Siskiyou Co., CA, and Klamath Co., OR; Upper Klamath Lake, Klamath Co., OR; probably once very widespread in this area.

Current distribution: Middle and upper Klamath River, but now very sporadic (absent from impoundments and polluted stretches), Siskiyou Co., CA; Upper Klamath Lake and major spring-fed tributaries, Klamath Co., OR, including sites in Winema and Rogue River National Forests and Upper Klamath Lake National Wildlife Refuge. Other localities are on Medford District BLM lands.

We have collected this species recently from a total of 22 sites (Table 3). Note limited penetration into Link River (or sporadic occurrence) and limited occurrence in the Hagelstein Park area, where it overlaps with *Fluminicola* n. sp. 27 (and is replaced by it?) in only a small area.

Threats: Much of Upper Klamath Lake is strongly eutropified, so that live populations of this species are restricted to areas with spring influx or influence, even though dredged shells indicate past ubiquity in the lake. This hydrobiid is absent from or rare in slow-moving or polluted impoundments, such as reservoirs. Springs in the lake bottom proper are badly affected by past dredging to facilitate log transport and by current severe nutrient enhancement and sedimentation. The species does not occur in areas with dense beds of such macrophytes as *Myriophyllum* and *Elodea*, nor in area subject to eutropification or periodic hypoxic episodes. Many springs in the area are so heavily grazed as to completely extirpate or greatly reduce this species. Others are connected to irrigation canal systems; resulting sedimentation and eutropification either eliminates or greatly reduces this species. Channeling for such systems, and for log transport long ago, has also much reduced habitat, even when water quality remains excellent.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate; ongoing and past threats; very substantial reduction in habitat. This species is undoubtedly declining in numbers and in number of sites. From first-year results of this survey, we do not anticipate major increase in either the geographic range of, or the number of sites with, this taxon.

Recommended status: This species has no special status at present; but is a ROD species (ROD, 1994). It was recommended for listing by Frest & Johannes (1993b, 1995a, d, 1996a). It should minimally be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to indicate that Federal and State (OR) listing as Endangered is appropriate, in our opinion. In mitigation for listed and candidate fish species in the Upper Klamath Lake area, care should be taken to avoid impact to this species, which can occur in sucker spawning areas.

References: Frest & Johannes (1993b, 1995a, d, 1996a, b); ROD (1994); Deixis collections, 1991-1997.

***Fluminicola* n. sp. 2 tall pebblesnail**

Map D3

Type locality: None designated; undescribed species.

Description: See final report for description. The tall conical conch, moderate size, black body, tentacles, and viscera, and flanged penis are distinctive features. The distinctive verge of this and several other Upper Klamath Lake drainage taxa may merit separation as a genus. This taxon was cited identically in Frest & Johannes (1993b, 1995a, d, 1996a, b).

Ecology: Confined to large undisturbed, very cold oligotrophic springs draining into Upper Klamath Lake, Klamath Co., OR. The species occurs on pebbles and cobbles and is a perilithon grazer. Few macrophytes are present, except for local *Veronica*. Most striking at one site are large numbers of *Nostoc pruniforme*, which in some areas cover the substrate like cobbles. A crenophile, and perhaps limnocrene only, species. A perilithon grazer and lithophile.

Original distribution: Likely restricted to larger springs tributary to Upper Klamath Lake and related drainages, CA-OR (especially Klamath Co., OR).

Current distribution: Known from a few sites, on private land adjacent to Winema National Forest, on nearby Upper Klamath Lake National Wildlife Refuge, and on Winema National Forest lands. At present, this species can be ascribed with certainty to a single site (Table 3); others require further work for confirmation.

Threats: Springs in the lake bottom proper are badly affected by past dredging to facilitate log transport and by current severe nutrient enhancement and sedimentation. The species does not occur in areas with dense beds of such macrophytes as *Myriophyllum* and *Elodea*, nor in areas subject to eutropification or periodic hypoxic episodes. Many springs in the area are so heavily grazed as to completely extirpate or greatly reduce this species. Others are connected to irrigation canal systems; resulting sedimentation and eutropification either eliminates or greatly reduces this species. Channeling for such systems, and for log transport long ago, has also much reduced habitat, even when water quality remains excellent. Areas used for log transport or storage still have not regained populations of this species.

Criteria for inclusion: Local endemic; likely occurrence on public lands; riparian associate. From first-year results, we do not anticipate that further finds will greatly expand either the range or site totals.

Recommended status: Has none at present, although it is a ROD species (ROD, 1994). It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to indicate that this species should be federally listed as Endangered; it should be listed similarly in OR. This recommendation was made previously in Frest & Johannes (1993b, 1995b, d, 1996a).

References: ROD (1994); Frest & Johannes (1993b, 1995b, d, 19967a, b); Deixis collections, 1991-1997.

***Fluminicola* n. sp. 3** **Klamath Rim pebblesnail**

Map D3

Type locality: None has been designated yet for this recently discovered species.

Description: See Frest & Johannes (1995b, 1995d). Distinctive features of this taxon are the small size, rather evenly gray body and tentacles, and narrow, elongate, sickle-shaped penis. This taxon was cited under the same name in Frest & Johannes (1993b, 1995a, d, 1996a, b).

Ecology: Small cold spring run; very shallow water; gravel-cobble substrate; no macrophytes present. The snail occurs only in shaded areas and may be photophobic. A perilithon grazer and lithophile.

Original distribution: Uncertain; likely restricted to the middle portion of the Klamath drainage, *i.e.* below Upper Klamath Lake and above Copco Reservoir; Klamath Co., OR and Siskiyou Co., CA.

Current distribution: Two sites in Klamath Co., OR, on Medford District BLM lands. The area is currently badly grazed; adjacent springs do not have this species. One site is so badly degraded that continued survival of the snail is doubtful. Judging from first-year results it is unlikely that future work will expand the geographic range and number of sites sufficiently as to militate against listing. In the portion of the UKL drainage surveyed here, there appears to be a single site so far.

Threats: Grazing is severe in the region, and badly affects the only known sites. Springs in the area either lack mollusks due to heavy grazing or have other mollusk species. Diversion and capping of springs for stock usage is widespread in this area, and has eliminated many springs.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate.

Recommended status: This species has no special status at present; but was designated a ROD species recently (ROD, 1994). It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal and State (OR) listing as Endangered is appropriate; this species was recommended for listing previously by Frest & Johannes (1993b, 1995a, 1996a, b). There is sufficient recently-collected information, and recent survey work, to demonstrate that listing is justified.

References: Frest & Johannes (1993b, 1995a, d, 1996a, b); ROD (1994); Deixis collections, 1991.

Fluminicola n. sp. 7 Tiger Lily pebblesnail

Map D4

Type locality: Will be designated when the species is described.

Description: This is a small-medium sized low conical species with convex whorls; dark gray body; black snout and tentacles; moderate-length sickle-shaped unpigmented verge with moderately wide base and folds on the basal third; round aperture, with barely reinforced columella. For details, see final report. This taxon was cited identically in Frest & Johannes (1995a, d, 1996a).

Ecology: Occurs only in medium-large oligotrophic cold, clear springs, generally with common wood fragments; mud-cobble (basalt and pumice) substrate; common *Rorippa* and *Mimulus*. Sites are generally in rich, partly open meadows and edges of *Pinus ponderosa* forest, with abundant sedges and grasses; *Saxifraga*; *Aconitum*; *Pyrola* spp.; *Spiranthes*; *Viola*, and other forbs. Springs are commonly associated with bogs or marshes. Water depth is shallow, and moderate to swift flow is characteristic. This crenophile species is primarily a lithophile and grazer of aufwuchs on stone surfaces, usually sides and undersides on cobbles. In quiet areas, this species will graze aufwuchs from macrophyte surfaces as well.

Original distribution: Probably abundant in the W. and N. parts of the Upper Klamath Lake drainage, Klamath Co., OR.

Current distribution: Still present in the less damaged portions of the larger springs on the NW side of Upper Klamath Lake. Some sites are on public lands, including Winema National Forest, BLM, and Klamath Lake National Wildlife Refuge. We currently (Table 3) recognize 16 sites for this species. Note that all are concentrated into the NW corner of the UKL drainage proper.

Threats: Many springs in the area are so heavily grazed as to completely extirpate or greatly reduce this species. Others are connected to irrigation canal systems; resulting sedimentation and eutropification either eliminates or greatly reduces this species. Channeling for such systems, and for log transport long ago, has also much reduced habitat, even when water quality remains excellent. Areas used for log transport or storage still have not regained populations of this species. This taxon does not do well in impounded areas.

Criteria for inclusion: Local endemic; occurrence on public lands; loss of much of habitat. This species has undoubtedly declined from pre-settlement population levels.

Recommended status: This species has no special status at present. It should minimally be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. We recommend Federal and State (OR) listing as Threatened; there is sufficient recently-collected information, and recent survey work, to support this action, as previously recommended in Frest & Johannes (1995a, d, 1996a).

References: Frest & Johannes (1995a, d, 1996a); Deixis collections, 1990-1997.

Fluminicola n. sp. 8 — Lost River pebblesnail

Map D5

Type locality: None designated as yet; undescribed species.

Description: See final report. The comparatively large globose shell; flanged verge; and body pigment pattern are distinctive. Cited under the same name in Frest & Johannes (1995a, d, 1996a)

Ecology: At present, found only in springs or strongly spring-influenced portions of a medium-sized river. The species seems to prefer cold, clear water, coarse (gravel-cobble) substrate, and slow to swift, constant flow. This species is a lithophile and grazer of aufwuchs on stone surfaces, usually sides and undersides on cobbles. In quiet areas, this species will graze aufwuchs from macrophyte surfaces as well. Areas with this species have dense *Rorippa* stands, often with beds of other macrophytes (*Ceratophyllum*, *Elodea*, *Potamogeton crispus*, and *Potamogeton filiformis* nearby. The species is absent from areas which are strongly eutropified or seasonally have hypoxic or anoxic conditions. At one site, this species occurs with an unusual *Vorticifex* sp., *Pyrgulopsis* n. sp. 2 [Big Spring springsnail, *q.v.*], and common *Physella gyrina*.

Original distribution: Probably once widespread in the Lost River portion of the Upper Klamath drainage, Klamath Co., OR.

Current distribution: Found only in a couple of springs in the Lost River drainage and a few spring-influenced areas in the river itself. At present, survival can be confirmed at 11 nearby sites (Table 3).

Threats: Much of the Lost River receives nitrogen- and phosphorous-enriched runoff from farming, and the river is extensively integrated into the Upper Klamath Project. Much is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Flow is now very slow and reduced in volume seasonally in much of the system. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; drastic decline in habitat condition and area.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to suggest that Federal and State (OR) listing as Endangered is appropriate for this taxon (as recommended also by Frest & Johannes, 1995a, d, 1996a).

References: Frest & Johannes (1995a, d, 1996a); Deixis collections, 1994-1997.

Fluminicola n. sp. 9 — Wood River pebblesnail

Map D4

Type locality: Will be designated when the species is formally described and named.

Description: See final report. Distinctive features of this species are the small, blunt-topped subconical shell; gray body; and open umbilicus. Cited in the same manner in Frest & Johannes (1995a, d, 1996a).

Ecology: Found in small-large spring complexes, generally with mixed mud-gravel (white pumice) substrate. Common bryophytes, *Rorippa*, *Mimulus*, sometimes *Myriophyllum*, *Potamogeton filiformis*, *Rivularia* and small *Nostoc*; most sites are well-shaded, in largely closed, rich *Pinus ponderosa* forest. This species is often found in small numbers in springs with other *Fluminicola* spp.; evidently an obligate crenophile, mostly a perilithon grazer.

Original distribution: Probably widespread on the N. end of Upper Klamath Lake, including part of the Williamson River and its major tributaries.

Current distribution: Known from a few large spring sites near the source of the Wood River and on the NE end of Upper Klamath Lake. Some of the known sites are on State of Oregon or Winema National Forest lands. At present, we recognize this species from a total of fifteen sites (Table 3); there is some possibility that it is composite.

Threats: Much of the Wood River valley is heavily used for agriculture, including grazing. Large areas receive nitrogen- and phosphorous-enriched runoff from farming, and the river is extensively integrated into the Upper Klamath Project. Much is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Flow is now very slow and reduced in volume seasonally in much of the system. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; heavy human impacts to most of habitat.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that Federal and State (OR) listing as Endangered is appropriate, as recommended also by Frest & Johannes (1995a, d, 1996a).

References: Frest & Johannes (1995a, d, 1996a); Deixis collections, 1991-1997.

Fluminicola n. sp. 16 **Keene Creek pebblesnail**
Map D3

Type locality: Will be designated as part of the formal species description.

Description: See final report. Distinctive features of this species are the medium, blunt-topped subconical shell; gray body; and sickle-shaped verge, with or without subepithelial pigment bar. Cited in the same manner in Frest & Johannes (1993b, 1995d, 1996a). This taxon could be composite, which would make individual taxa even more restricted in range than indicated here.

Ecology: Found in small to medium-sized springs and spring-influenced creeks.

Original distribution: Probably restricted to portions of the middle Klamath drainage in Jackson Co. and western Klamath Co., OR and part of Siskiyou Co., CA.

Current distribution: Seems restricted to portions of the Jenny Creek drainage; some sites are on Medford District and Klamath Falls District BLM lands, including areas within DCA OD-22. During the second year of survey for this project an additional site for this species was found in Johnson Creek; this remains the only site in the survey area.

Threats: Much of Johnson Creek is impacted by grazing and logging. Small scale dredging of creek and impoundment of the creek have resulted in local extirpation. For problems with the Jenny Creek populations, see below and Frest & Johannes (1993a, 1996b)

Criteria for inclusion: Local endemic; occurrence on public lands, including a DCA; riparian associate.

Recommended status: Has no status at present. Probably should be listed as Endangered (both by the state of OR and federally), as recommended also by Frest & Johannes (1995d, 1996a). Much of the Jenny Creek system has been modified for a municipal water system (Yreka, CA); there are major reservoirs on Keene Creek and Jenny Creek, and a major flume system eliminated or modified many springs along the Jenny Creek corridor. Most of the smaller springs have been grazed out, and there is extensive grazing impact along some portions of the larger creeks.

References: Frest & Johannes (1995d, 1996a); Deixis collections, 1991-1995.

Fluminicola n. sp. 27 **Crooked Creek pebblesnail**
Figure 13; Map D2

Type locality: Will be designated when the species is formally described and named.

Description: See final report. Distinctive features of this species are the large, subconical, distally decollate shell; black body; *seminalis*-like but pigmented verge; and closed umbilicus. Formerly (Frest & Johannes, 1995d) cited as *Fluminicola* n. sp. 10. Cited as above in Frest & Johannes (1996a).

Ecology: Found in medium-large cold spring complexes and spring-influenced streams, generally with mixed mud-gravel (often basalt or pumice) substrate. Common bryophytes, *Rorippa*, *Mimulus*, sometimes *Myriophyllum*, *Potamogeton filiformis*, *Rivularia* and small *Nostoc*; most sites are well-shaded, in largely closed, rich *Pinus ponderosa* forest. This species is often found in small numbers in smaller springs with other *Fluminicola* spp.; evidently an obligate crenophile, mostly a perilithon grazer.

Original distribution: Probably widespread on the N. and NE end of Upper Klamath Lake, Including Crooked Creek and its major tributaries.

Current distribution: Known from a few large spring sites and streams on the NE end of Upper Klamath Lake. Some of the known sites are on State of Oregon or Winema National Forest lands. At present, we recognize this species from a total of 60 sites (Table 3); there is a good possibility that it is composite, which would limit the range of each component taxon even more than recognized here. For example, it seems likely that the Hagelstein Park populations, about 1/4 of the total sites, are a separate taxon. Further study should resolve this problem.

Threats: Much of the Crooked Creek area is heavily used for agriculture, including grazing. Large areas receive nitrogen- and phosphorous-enriched runoff from farming, and the stream and surrounding large springs are integrated small-scale irrigation projects or used for domestic or hatchery water supply. Much of the creek is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; heavy human impacts to most of habitat.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that Federal and State (OR) listing as Endangered is appropriate, as recommended also by Frest & Johannes (1995d, 1996a).

References: Frest & Johannes (1995d, 1996a); Deixis collections, 1991-1997.

Fluminicola n. sp. 28 Odessa pebblesnail

Map D5

Type locality: Will be designated when the species is formally described and named.

Description: See final report. Distinctive features of this species are the large, fairly tall subconical shell; black body; flanged verge; and open umbilicus. Formerly (Frest & Johannes, 1995d) cited as *Fluminicola* n. sp. 11. Cited as above in Frest & Johannes (1996a).

Ecology: Found in small-large spring complexes and runs, generally with mixed mud-gravel (basalt or pumice) substrate. Common *Rorippa*, *Mimulus*, sometimes *Myriophyllum*, *Potamogeton filiformis*, *Rivularia* and small *Nostoc*; most sites are in rather open meadow or in sparse *Pinus ponderosa* forest. This species is often found with other *Fluminicola* spp.; evidently an obligate crenophile, mostly a perilithon grazer.

Original distribution: Probably widespread on the NW end of Upper Klamath Lake.

Current distribution: Known from a few large spring sites (we currently recognize 4; see Table 3) in the Odessa Creek area. The known sites are on Winema National Forest or National Wildlife Refuge lands.

Threats: Much of the Odessa Creek area, including the source spring, is heavily used for agriculture, including grazing. Large areas receive nitrogen- and phosphorous-enriched runoff from farming, and the creek is extensively integrated into the Upper Klamath Project. Much is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; heavy human impacts to most of habitat.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that Federal and State (OR) listing as Endangered is appropriate, as suggested previously by Frest & Johannes (1995d, 1996a).

References: Frest & Johannes (1995d, 1996a); Deixis collections, 1991-1997.

***Fluminicola* n. sp. 29 Ouxy Spring pebblesnail**

Map D3

Type locality: Will be designated when the species is formally described and named.

Description: See final report. Distinctive features of this species are the small, blunt-topped turbinate shell; gray body; thin, unpigmented, sickle-shaped verge; and thick shell. Formerly (Frest & Johannes, 1995d) cited as *Fluminicola* n. sp. 12; cited inFres t& Johannes (1996a) as *Fluminicola* n. sp. 29.

Ecology: Found in a single small-large spring complex, with mixed mud-gravel (red basalt-pumice) substrate. Common *Rorippa*, rare *Mimulus*, *Potamogeton filiformis*, *Rivularia* and small *Nostoc* are accompanying macrophytes, although much of the area has epiphytic algae only. This species is evidently an obligate crenophile, mostly a perilithon grazer. The sites are spawning areas for two endemic sucker species.

Original distribution: Probably widespread on the E. side of Upper Klamath Lake, in the vicinity of Modoc Rim.

Current distribution: Known only from two sites currently, both in the same spring complex on the E. side of Upper Klamath Lake. Part of the known sites are on Winema National Forest lands.

Threats: Much of the Wood River valley is heavily used for agriculture, including grazing. Large areas receive nitrogen- and phosphorous-enriched runoff from farming, and the river is extensively integrated into the Upper Klamath Project. Much is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Flow is now very slow and reduced in volume seasonally in much of the system. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; heavy human impacts to most of habitat; occurrence with endangered sucker species.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that Federal and State (OR) listing as Endangered is appropriate (as previously suggested by Frest & Johannes, 1995d, 1996a).

References: Frest & Johannes (1995d, 1996a); Deixis collections, 1991-1997.

Fluminicola n. sp. 30 **Casebeer pebblesnail**

Map D3

Type locality: Will be designated when the species is formally described and named.

Description: See final report. Distinctive features of this species are the small, blunt-topped subturbinate shell with nearly angulate periphery; gray body; and broadly flanged verge. Formerly (Frest & Johannes, 1995d) referred to as *Fluminicola* n. sp. 13; but under *Fluminicola* n. sp. 30 in Frest & Johannes (1996a).

Ecology: Found in one large spring complex, with mixed mud-gravel (basalt) substrate. Common bryophytes, *Rorippa*, *Mimulus*; in largely open, dry *Pinus ponderosa* forest. This species is evidently an obligate crenophile, mostly a perilithon grazer. *Physella virgata* is the only other mollusk seen thus far.

Original distribution: Probably widespread on the E. end of the Lost River drainage.

Current distribution: Known thus far just from a single site, privately owned. At least 6 other adjacent sites lack the species.

Threats: Much of the Lost River valley is heavily used for agriculture, including grazing. Large areas receive nitrogen- and phosphorous-enriched runoff from farming, and the river is extensively integrated into the Upper Klamath Project. Much is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Flow is now very slow and reduced in volume seasonally in much of the system. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. All other springs in the complex with this species , for example, are either completely diverted or so affected as to lack any mollusks. This spring is also heavily grazed; but partly protected by fencing; and survives in part because of its large size. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; heavy human impacts to most of habitat.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that Federal and State (OR) listing as Endangered is appropriate (as previously suggested by Frest & Johannes, 1995d, 1996a).

References: Frest & Johannes (1995d, 1996a); Deixis collections, 1991-1995.

Fluminicola n. sp. 31 Lake of the Woods pebblesnail
Map D5

Type locality: Will be designated when the species is formally described and named.

Description: See final report. Distinctive features of this species are the small, blunt-topped subconical shell; gray body; narrow, unpigmented verge; and small, open umbilicus. Formerly (Frest & Johannes, 1995d) cited as *Fluminicola* n. sp. 14; and cited as above in Frest & Johannes (1996a).

Ecology: Found in small-large spring complexes, generally with mixed mud-gravel (basalt or pumice) substrate. Macrophytes include common bryophytes, *Rorippa*, *Mimulus*, less common *Myriophyllum*, *Potamogeton filiformis*, *Rivularia* and small *Nostoc*. Most sites are comparatively open, in dry *Pinus ponderosa* forest. This species is often found in small numbers in springs with other *Fluminicola* spp.; evidently an obligate crenophile, mostly a perilithon grazer.

Original distribution: Probably widespread on the SW end of Upper Klamath Lake and in portions of the Lost River drainage.

Current distribution: Known from a few spring sites near the Lake of the Woods: sites in part of the Lost River drainage are now placed in Fluminicola n. sp. 42 (see below). Some of the known sites are on State of Oregon or Klamath District BLM lands. At present, we recognize this species from a total of 10 sites (Table 3); there is some possibility that it is composite, even with Lost River sites removed; we are planning additional work on this taxon.

Threats: Much of the Lost River valley is heavily used for agriculture, including grazing. Large areas receive nitrogen- and phosphorous-enriched runoff from farming, and the river is extensively integrated into the Upper Klamath Project. Much is heavily affected by siltation, and is choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Flow is now very slow and reduced in volume seasonally in much of the system. Sections affected by the factors listed above have lost much of the native mollusk fauna, which may include this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. This species is definitely declining, in terms of both numbers and habitat area and condition.

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Criteria for inclusion: Local endemic; heavy human impacts to most of habitat.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that Federal and State (OR) listing as Endangered is appropriate, as suggested by Frest & Johannes (1995d, 1996a).

References: Frest & Johannes (1995d, 1996a); Deixis collections, 1991-1997.

***Fluminicola* n. sp. 42 Duncan pebblesnail**
Map D5

Type Locality: Will be designated when the species is completely described and named.

Description: This is a medium-sized (height 6.5-7.25 mm at 3 3/4-4 whorls if not decollate; more commonly, 3.5-4.5 mm at 2 3/4 whorls, decollate) species; shell moderately high conical, spire tip usually decollate; teleoconch whorls somewhat convex, often strongly shouldered near suture; shell opaque, light gray or white; periostracum yellow-green. Outer lip thin; columella reinforced moderately; axial ridge small, generally disappearing before axis; umbilicus closed. Aperture broad, lunate, columella not thickened notably across pariety; parietal and basal lip thin. Snout and tentacles usually almost black; light eyespots present; neck and most of body medium gray; visceral coil black. Penis medium- to large-sized, broadly sickle-shaped, not folded basally; gradual and rather minor taper distally, but with typical narrow, papilla-like tip; epithelial pigment light overall, less toward tip; single central subepithelial pigment band also.

Discussion: This taxon bears some resemblance to *F. modoci* (*q.v.*); but size and penial features are distinctive. There is also some resemblance to the Metolius pebblesnail [*Fluminicola* n. sp. 4 of Frest & Johannes, 1998, in press]

Ecology: The species is generally found in large or medium-sized, composite cold springs or spring-influenced portions of rivers; abundant *Rorippa* when not disturbed; common *Mimulus*; less common *Veronica* below and bryophytes near source; substrate mixed sand, gravel, with local basalt cobbles.

Original range: Probably common in the Lost and Sprague river drainages, Oregon.

Current range: Found at eighteen sites: see Map D5.

Threats: Springs in the area, including this one, are heavily grazed periodically. Some have been diverted for livestock or human usage, both as a water supply and for irrigation. The two rivers in which this taxon occurs are heavily agriculture-influenced, with siltation and increased nutrient loads very evident. Major portions are impounded or diverted into irrigation systems or receive irrigation wastewater.

Criteria for inclusion: Occurrence on public lands; limited distribution; threats to known sites and others in the area.

Recommended status: This species has no special status currently. It should probably be regarded as Threatened both federally and by the state of Oregon. Minimally, it should be considered a Sensitive species by BLM, Forest Service, and other appropriate State and federal wildlife and land management agency personnel.

References: Frest & Johannes (1998, in press); Deixis collections, 1991-1997.

Helisoma (Carinifex) newberryi newberryi (Lea, 1858) Great Basin rams-horn

Type locality: Rising River, Hat Creek, Shasta Co., CA. Probable holotype USNM 120991; probable paratype USNM 9256.

Description: The best description and illustrations are in Baker (1945); see also figures in Burch (1989). *Carinifex* has often been accorded separate generic status, which seems reasonable in view of its internal anatomy, at least as described by Baker (1945) and very different ecology from *Helisoma* (*s.s.*). Be that as it may, we follow Taylor (1981) and Burch (1989) for the time being in regarding *Carinifex* as a subgenus. Burch (1989), noting comments of previous authors, opined that there may be only *a* single living species of *Carinifex*, and relegated most of the former species to the status of subspecies. It is amusing to note that the major author so quoted, Henry Pilsbry, was himself the author of two additional subspecies. This (sub)genus needs detailed work; however, we would note that, at least as described by Baker (1945) there appear to be very substantial anatomical differences between *jacksonense* and *ponsonbyi*, treated by Burch as a form of *newberryi newberryi*. One form, *Helisoma (Carinifex) minor* (J. G. Cooper, 1870), was overlooked by Burch (1989); this is likely a full species, as indicated by Taylor (1981). Cited as *Helisoma (Carinifex) newberryi newberryi* (Lea, 1858) in Frest & Johannes (1991b, 1993b, 1995a, d, 1996a).

Ecology: "Larger lakes and slow rivers, including larger spring sources and spring-fed creeks. The snails characteristically burrow in soft mud and may be invisible even when abundant." (Taylor, 1981). Can occur with *Pisidium ultramontanum*, *Lanx klamathensis*, or several other endemic mollusks, particularly *Fluminicola* spp. Areas with this species generally have well-oxygenated but soft substrate; macrophytes such as *Chara*, *Myriophyllum*, *Elodea*, *Veronica*, and *Potamogeton filiformis* common but not abundant; and clear, very cold, slowly flowing water. Typically, they are very large spring pools or strongly spring-influenced areas in larger streams or lakes. This form is one of the few to be found generally in Upper Klamath Lake. Deep-water populations differ somewhat in morphology from shallow-water lake and spring populations.

This pelophile species generally occurs just below the sediment surface and is a detritus feeder. The ecology, need for continually well-oxygenated soft substrate, and detritus-feeding habitat have long been known to be unusual for the family (Planorbidae) generally. Very few other planorbids are crenophiles or prefer limnocrenes; very few are cold-water stenotherms. The most closely analogous planorbids are members of the genus *Vorticifex*. See discussion in Frest & Johannes (1993c, 1994, 1995b. 1996a).

Original distribution: Taylor & Smith (1981) and Taylor (1985) illustrate a total of 14 historic sites for all forms of the species.; 1 in western WY, 3 in southwestern OR; 1 in UT; 7 in northeastern CA; and 2 in eastern CA. Many of these are either now known to be extinct or have not been recollected recently. The specialized habitat guarantees that not many more sites can be found; in any case, recent collection of the Upper Klamath Lake and Pit River drainages by us (see, *e.g.*, Frest & Johannes, 1993b, 1994a, 1995a, 1995b, 1996a) and of the Great Basin by R. Hershler and his collaborators, including us, indicates that few sites survive.

This species had an extensive distribution in the Plio-Pleistocene and even Holocene lakes in the Great Basin and Oregon Interior Basin; see Taylor (1985) and Figure 16 herein.

Current distribution: "In California known from six local drainages, in which the species survives in probably only four....Sheepy Creek [Siskiyou County; may now (visited in 1991) be extinct]...Pit River, including the large spring-pools and their outflows of Fall River and Hat Creek; known downstream to above Squaw Creek, but probably extinct in the lower segment of its range. Eagle Lake, Lassen County. Lake Tahoe and adjacent slow segment of its outflow, Truckee River...." (Taylor, 1981, p. 158). The UT (Utah Lake) and Owens Valley, CA populations are extinct. Some of the CA and OR sites are within the range of the Northern Spotted Owl. Surviving sites are in Winema National Forest, Upper Klamath Lake National Wildlife Refuge and in Lassen National Forest (*e.g.* Eagle Lake); others may be located on BLM lands in the vicinity of Fall River Mills, CA. Other sites are known from tributaries to Upper Klamath Lake (this survey); and offshore in deep water in the Lake proper. We currently recognize 17 sites in this drainage (Table 3).

Threats: Springs in Upper Klamath Lake proper are badly affected by past dredging to facilitate log transport and by current severe nutrient enhancement and sedimentation. The species does not occur in areas with dense beds of such macrophytes as *Myriophyllum* and *Elodea*, nor in areas subject to eutropification or periodic hypoxic episodes. Many springs in the Great Basin and Oregon Interior Basin are so heavily grazed as to completely extirpate or greatly reduce this species. Others are connected to irrigation canal systems; resulting sedimentation and eutropification either eliminates or greatly reduces this species. Channeling for such systems, and for log transport long ago, has also much reduced habitat in the Upper Klamath Lake area, even when water quality remains excellent. Areas used for log transport or storage still have not regained populations of this species.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate; very specialized and uncommon habitat; past and current threats to habitat; reduction in numbers and loss of historic sites.

Recommended status: Currently has none. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to demonstrate that this taxon should be Federal and State (OR and CA) Endangered, in our judgment, just as previously suggested by Frest & Johannes (1991b, 1993a, b, 1994a,1995a, b, d, 1996a).

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References: Taylor (1981); Taylor & Smith (1981); Taylor (1985); Frest & Johannes (1991b, 1993a, b; 1994a; 1995a, b, d, 1996a); Deixis collections, 1989-1997.

Lanx alta (Tryon, 1865) highcap lanx

Map D8

Type locality: Klamath River (no specific locality). Holotype ANSP 21960a.

Description: The best description and illustrations are those of Baker (1925). See also illustrations in Burch (1989). Distinctive shell features of this lancid are the relatively large, evenly dark red shell and height about 2/3 of greatest shell length. Burch (1989) recognizes subgenera in *Lanx*, but, like Taylor (1981) we see no reason at present for distinguishing *Walkerola*

Hannibal, 1912, which is based solely on the low shell. Cited under the same name in Frest & Johannes (1995a, d, 1996a).

Ecology: "Large rivers and major tributaries, on boulders or rock in current" [Taylor (1981, p. 157)]. Low to medium elevations; the species is an amniphile, perilithon feeder, and lithophile found in areas with stable cobble-boulder substrate and excellent water quality. Like other lancids, this species respires through an unusual system unique for pulmonates; a heavily vascularized mantle and enlarged heart are elements (Baker, 1925). Lack of gills or lungs typical of many pulmonates limit the habitat of the lancids generally to areas not subject to hypoxia or anoxia, and generally to cold, clear, flowing waters, especially oligotrophic streams and areas with considerable spring influence.

Original distribution: "Drainages of Umpqua and Klamath rivers, OR, to South Fork of Trinity River (tributary to Klamath River), California; Smith River, California" (Taylor, 1981, p. 157). Counties are Josephine, Jackson, and Curry on the Rogue River (including sites in Siskiyou National Forest: sites in Rogue River National Forest may be extirpated); and Del Norte, Humboldt, and Siskiyou cos. [CA], plus Klamath Co., OR (Klamath River). Old sites were in Winema, Klamath, Six Rivers, and Trinity National Forests. Some of these sites are known to survive. The species also occurs in the Rogue National Wild and Scenic River. Relevant to this work are occurrences in the upper part of the Klamath River below Link River and in the Williamson River.

Current distribution: Recently (1991-95) collected alive by us in the Klamath River in CA and Rogue River in OR; now extinct in most of the Klamath River and part of the Rogue River; status in other rivers in its range uncertain. Umpqua specimens are better assigned to *Lanx subrotunda* (*q.v.*), as in Burch (1989).

Systematic position of populations in the Williamson River and in large nasmodes, collected by us from 1991-1995, is not yet clear, although these bear some resemblance to *Lanx alta*. See final report for discussion. We so far recognize 8 sites for this species locally.

Threats: Much of the upper Klamath River is impounded; the species does not generally occur in such areas. *Lanx alta* is also absent from areas downstream from waste water returns, *i.e.* below as well as in John Boyle Reservoir. Warm, slow, nutrient-enriched, or turbid water also lack this species, so that much of the Klamath and Rogue rivers are now unsuitable habitat.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate.

Recommended status: Currently has none. We recommended listing of this species previously (Frest & Johannes, 1991b, 1993b, 1995a, d, 1996a). Minimally, it should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Existing evidence is sufficient that this species should be Federal and State (OR and CA) Endangered.

References: Taylor (1981); Burch (1989); Frest & Johannes (1991b, 1993b, 1995a, d, 1996a); Deixis collections, 1991-1997.

Lanx klamathensis Hannibal, 1912 scale lanx

Figures 5, 15; Map D8

Type locality: South end of Upper Klamath Lake, Klamath Falls, Klamath Co., OR. Types in CAS collections.

Description: See Hannibal (1912) and Baker (1925); the illustration in Burch (1989) is also helpful. The low and thin shell, many times wider and longer than high, is quite characteristic. Hannibal (1912) erected the subgenus *Walkerola* for this species; Burch (1989) recognizes this; but we, like Taylor (1981) see no reason at present to do so. Shell height *vs.* width in *Lanx* is better regarded as a species-level character. Cited identically in Frest & Johannes (1993b, 1995a, d, 1996a).

Ecology: A form restricted to large, spring-fed lakes and streams and limnocrene springs. The species, like all lancids, is an obligate perilithon grazer and lithophile, and occurs on cobbles and boulders, generally in areas with current and always at sites with oxygenated, high-quality clear water. This species commonly is found with a variety of other rare forms, including *Pyrgulopsis archimedis*, *Pyrgulopsis* n. sp. 1, *Lyogyrus* spp., *Fluminicola* spp., and *Vorticifex klamathensis klamathensis*. Lack of gills or lungs typical of many pulmonates limit the habitat of the lancids generally to areas not subject to hypoxia or anoxia, and generally to cold, clear, flowing waters, especially oligotrophic streams and areas with considerable spring influence.

Lake-living species of *Lanx* appear to have been relatively widespread in some of the OR Interior Basin Pliocene-Pleistocene lakes, such as that once existing near Ft. Rock. Most such lakes are either now dry or are alkaline, which condition is inimical to most mollusk species, including this one. This appears to be the last surviving lake species.

Original distribution: Upper Klamath Lake basin, Klamath Co., OR and Siskiyou Co., CA, likely including Lower Klamath Lake and Tule Lake as well as Upper Klamath Lake. Occurrence in Lake of the Woods uncertain.

Current distribution: Survives at a few spring-buffered sites in the Upper Klamath Lake, area, including the Link River and localities in Winema National Forest and Upper Klamath Lake National Wildlife Refuge. The Tule Lake population (Tule Lake National Wildlife Refuge) may be extinct. Other sites are possible in the same areas and in Rogue River National Forest. Population trends in this species, both in terms of sites and numbers, are clearly downward. Judging from survey work thus far, significant range extensions or the location of large numbers of additional sites are very unlikely. At present, we have noted 18 sites for this species (Table 3).

Threats: Much of the lake habitat for this Upper Klamath Lake drainage endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Agency Lake populations appear to be extinct, dating at least from the drying of this area in 1993. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified. Even in the best remaining spring pools and spring-fed creeks, the species seems to be confined to limited areas with the best water quality. Most large springs and spring-fed pools are also heavily grazed currently; the species does not seem able to tolerate such disturbance.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate; extensive human modification to rather specialized habitat; ongoing threats.

Recommended status: Currently has none. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient information of recent vintage exists to establish that this species should be Federal and State (OR and CA) Endangered, as previously suggested by Frest & Johannes, 1993b, 1995a, d, 1996a.

References: Baker (1925); Taylor (1981); Burch (1989); Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, 1991-1997.

***Lyogyrus* n. sp. 3** **Klamath duskysnail**

Figure 6; Map D9

Type locality: Undescribed taxon; none yet designated.

Description: This small (under 1.5 mm as adult) species has a light yellow, mostly translucent shell, small flat protoconch, and low conical spire of about 3 convex whorls. The shell surface is smooth except for the initial whorls; the mantle is unpigmented, as is the body, including snout, tentacles, and external male genitalia. The aperture is rounded, slightly thickened on the columellar side, and has a sinuous outline, as well as being slightly prosocline. Nearest relationships are to the nodose duskysnail and a sister species confined to small portions of the Pit River drainage, Northern CA (Frest & Johannes, 1993a, b, 1994a, 1995b). The nodose duskysnail has a nodose shell with a distinctly higher spire. The CA species is smaller and has a more depressed spire, with a simply rounded peritreme. This taxon was cited as *Lyogyrus* n. sp. 4 in Frest & Johannes (1993b) and as above in Frest & Johannes (1995a, d, 1996a).

The above description applies particularly to Link River populations. Newly discovered populations in the Sprague and Williamson rivers are similar but orange in color; and seem to have both weak spiral and transverse lirations. It is possible that these populations are a different species (which would make both it and 3 even less common).

Ecology: Lives on undersides and sides of boulders and cobbles in a large lake, in areas with spring influence. Macrophytes are generally absent at its sites, and the species appears to be photophobic. This species frequently occurs with other rare mollusk taxa, such as *Lanx klamathensis*, *Pyrgulopsis archimedis*, *Pyrgulopsis* n. sp. 1, and *Vorticifex klamathensis klamathensis*. A perilithon grazer and lithophile, as are many of the western US species in this genus.

Sprague and Williamson populations live on the undersides of stones in areas with good flow, essentially riffles.

Original distribution: Upper Klamath Lake (both sides), including the Link River, Klamath Co., OR.

Current distribution: Known to survive at about 8 sites (Table 3), all somewhat sheltered from eutropification by spring influx, on private land and in Upper Klamath Lake National Wildlife Refuge and Winema National Forest. Other sites are possible in the same areas. From our survey results thus far, large numbers of additional sites are unlikely. Note that sites with the typical morphology appear to be confined to the Link River area.

Threats: Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified. Even in the best remaining spring pools and spring-fed creeks, the species seems to be confined to limited areas with the best water quality. Most large springs and spring-fed pools are also heavily grazed currently; the species does not seem able to tolerate such disturbance. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species. Most sites are themselves remnants, with large areas now lacking this species due to an earlier cycle of habitat modification.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate. Comprehensive survey of the Upper Klamath drainage is now underway; to date there is little reason to expect that many more site will be found.

Recommended status: Currently has none. We have previously (Frest & Johannes (1993c, 1995a, d, 1996a) recommended listing of this taxon. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (OR) Endangered.

References: Taylor (1985a); Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, 1990-1997.

Lyogyrus n. sp. 4 nodose duskysnail

Figure 16; Map D9

Type locality: Recently discovered taxon; none as yet.

Description: This diminutive (less than 1.5 mm spire height) taxon has a yellow translucent shell with about 3 convex whorls, a low conical spire, and prominent nodes on the upper whorls. The shell periphery is slightly angulate. It much resembles *Lyogyrus* n. sp. 3; but is taller, and that species lacks nodes. This taxon was cited as *Lyogyrus* n. sp. 5 in Frest & Johannes (1993b), and as above in Frest & Johannes (1995a, d).

We include in this taxon for the moment populations with rather taller spires (to 3.1 mm), dark mantles; and subepithelial pigment on the penis. These occur at Hagelstein Park and at two sites in Upper Klamath Lake proper, near Modoc Point. These could represent a separate taxon.

Ecology: Occurs on undersides and sides of cobbles and boulders in spring complex draining into Upper Klamath Lake and rarely in spring-influenced outflow from lake; *Rorippa* present, but snails on rocks only; species appears photophobic. Occurs with other Species of Special Concern, including *Pyrgulopsis archimedis*, *Pyrgulopsis* n. sp. 1, *Lanx klamathensis*, and *Vorticifex klamathensis klamathensis.* This lithophile species is a perilithon grazer and appears also to be a limnophile, absent from the numerous large springs and spring pools around Upper Klamath Lake, with the possible exception of Hagelstein Park.

Original distribution: Upper Klamath Lake and major spring tributaries, Klamath Co., OR.

Current distribution: Known from 8 sites on Upper Klamath Lake (Table 3), one in Winema National Forest; very rare at one site. A few other sites are possible in the Upper Klamath Lake basin, *e.g.* Upper Klamath Lake National Wildlife Refuge. First year and other recent survey results indicate that finds of large numbers of additional sites are improbable.

Threats: Much of the lake habitat for this Upper Klamath Lake drainage endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs draining directly into Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified. Even in the best remaining such spring pools and spring-influenced lake stretches, the species seems to be confined to limited areas with the best water quality. These are also Endangered sucker spawning areas, and care must be taken to avoid extirpating or further limiting the mollusk in order to enhance sucker populations.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate. Sufficient recent survey work has been done to indicate that this species is a very narrow endemic in need of protection, with most former habitat now lacking the species.

Recommended status: Has none at present. We have previously (Frest & Johannes (1993b, 1995a, d, 1996a) recommended listing of this taxon. The species should be listed as Endangered federally and by the State of OR. Sites are threatened by eutropification, urban and industrial pollution, and habitat modification to accommodate Endangered sucker species.

References: Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, 1992-1997.

Lyogyrus n. sp. 5 mare's egg duskysnail

Map D9

Type locality: Recently discovered, undescribed taxon; none yet designated.

Description: This taxon was cited as *Lyogyrus* n. sp. 6 in Frest & Johannes (1993b) and as herein in Frest & Johannes (1995a, d, 1996a). The small size, low but attenuate spire, and dark mantle are distinctive.

Ecology: Occurs on undersides of cobbles and boulders and of very large *Nostoc* colonies (locally termed mare's eggs) in spring-influenced sites in a large lake and a large, spring-influenced creek. Can occur with other Species of Special Concern, such as *Lanx klamathensis, Helisoma (Carinifex) newberryi,* and *Fluminicola spp.* A crenophile, lithophile, and perilithon feeder, perhaps photophobic as well.

Original distribution: Upper Klamath Lake and vicinity, Klamath Co., OR.

Current distribution: So far found at eight sites only (Table 3), one on private land interfingered with units of Winema National Forest and Upper Klamath Lake National Wildlife Refuge and 2 others apparently on Winema National Forest lands. A small number of additional sites could exist, in the areas mentioned previously and Upper Klamath Lake National Wildlife Refuge. From early results, it is evident that substantial range extension or increment of currently known live sites are very unlikely.

We are reviewing occurrences of this species, which may be composite. Note that sites are restricted to springs on the NW and NE sides of Upper Klamath Lake.

Threats: Much of the past or potential lake habitat for this Upper Klamath Lake drainage endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified. Even in the best remaining spring pools, spring-influenced lake areas, and spring-fed creeks, the species seems to be confined to limited portions with the best water quality. Most large springs and spring-fed pools are also heavily grazed currently; the species does not seem able to tolerate such disturbance.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate; modification and loss of most habitat; threats to rest of habitat.

Recommended status: At present has no special status. We have previously (Frest & Johannes (1993b, 1995a, 1996a) recommended listing of this taxon. Should be a federal and State of OR Endangered species. Upper Klamath Lake is badly eutropified, and this species seems to occur only in relatively unpolluted areas with strong, permanent spring influence. These are also commonly sucker spawning sites, hence subject to modification to enhance habitat for three listed Upper Klamath Lake fish species.

References: Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, 1992-1997.

Physa (Physa) skinneri Taylor, 1954 glass physa

Type locality: Beaver County, Oklahoma, Berends local fauna (Pleistocene), SE corner sec. 6, T 5 N R 28 E; holotype UMMZ 181292; specimens in numerous collections.

Description: A *Physa* (*s.s.*) species with a slender, elongate-ovoid, thin shell; maximum length *ca.* 8 mm; parietal callus thin, moderately wide; mantle narrowly reflected over outer lip, with narrow, elongate digitations in left-posterior and right-columellar groups; aperture elongate, about 60% of shell length; shell surface texture silky to shining. For anatomy, see Taylor (1988).

This taxon somewhat resembles the European genotype, *P. fontinalis* (Linnaeus, 1758); but that taxon is larger; the shell is less elongate; and the spire short and blunt. This species also resembles *P. megalochlamys* Taylor, 1988; but the latter is larger; has the shell more completely envelope by the mantle; the mantle digitations are characteristically broad and blunt; the spire apex is more protrusive; and the parietal callus is wider. See Taylor (1988) for more information.

Ecology: Usually found in persistent ponds, small lakes, or marshes, or in smaller streams associated with such lentic habitats. Often associated with *Planorbella (Pierosoma) subcrenata*; *Stagnicola* and *Lymnaea* spp., *Valvata humeralis*, and *Promenetus exacuous exacuous*.

Original distribution: Mostly western US, with scattered localities in eastern Siberia (Taylor, 1988b). US and Canadian localities in the following states: Alaska, Washington, Montana, Idaho, Nevada, Colorado, Minnesota, Wyoming, South Dakota, North Dakota, Nebraska, Utah, Yukon, British Columbia, Alberta, Manitoba. Outside of North Dakota, NE Utah, and western Wyoming, sites seem quite sparse. This is the first record from Oregon; and there are only two reported sites in Washington.

Current distribution: So far found at a single Oregon site (Table 3), a small high-elevation lake apparently on Fremont National Forest lands. A small number of additional sites could exist, in higher elevations of Winema and Fremont National Forests and Upper Klamath Lake National Wildlife Refuge. From early results, it is evident that substantial range extension or increment of currently known live sites are very unlikely.

Threats: Much of the past or potential lake habitat for this species is considerably eutropified; the species is absent from such areas. Most of the marshes peripheral to Upper Klamath Lake were modified for agriculture and are now part of irrigation projects; the species is absent from areas so modified. High-elevation lakes may be less affected. Most low-medium elevation lakes and ponds are also heavily grazed currently; the species does not seem able to tolerate such disturbance.

Criteria for inclusion: Regional endemic; occurrence on public lands; riparian associate; modification and loss of most habitat; threats to rest of habitat.

Recommended status: At present has no special status. Should be a State of OR Endangered species. Available marsh, small lake, and pond habitat in much of the Upper Klamath Lake drainage is badly eutropified or modified for agriculture; or subject to heavy grazing, and this species seems to occur only in relatively unpolluted and unmodified areas.

References: Taylor (1988); Deixis collections, 1997.

Pyrgulopsis archimedis **Berry, 1947** **Archimedes pyrg**

Figures 7, 17; Map D10

Type locality: Upper Klamath Lake in vicinity of Algoma, Klamath Co., OR.

Description: For comprehensive description and illustration of both shell and soft part morphology see Hershler (1994). There are only two strongly carinate western North American *Pyrgulopsis* species: this and the genotype, *Pyrgulopsis nevadensis*. This species is more strongly carinate; larger; and has a less attenuate spire.

This species was first reported from Upper Klamath Lake some time before its description (Henderson, 1924, 1929, 1936b; Hanna, 1930; Clench, 1940). Berry (1947) was the first to recognize its distinctness, which has since been conclusively demonstrated (Hershler, 1994). Limnophile *Pyrgulopsis* species are unusual, although more common in the Interior Basin (OR) Pliocene-Pleistocene pluvial lakes. This species was cited identically in Frest & Johannes (1993b, 1995a, d, 1996a).

Ecology: Large-lake hydrobiid, now surviving only in areas with spring influence to counter eutropification and subsequent periodic low DO_2. This taxon prefers areas with gravel-boulder (basalt and pumice) substrate and few macrophytes. It occurs with several other Species of Special Concern, namely *Lanx klamathensis, Pyrgulopsis* n. sp. 1, *Pisidium ultramontanum, Lyogyrus* n. sp. 4, *Fluminicola* n. sp. 1, and *Vorticifex klamathensis klamathensis*. It is a perilithon feeder, generally grazing on lower and lateral sides of larger stones, and a lithophile.

Original distribution: Upper Klamath Lake and Tule Lake, Klamath Co., OR and Siskiyou Co., CA; likely occurred also in Lower Klamath Lake as well. The related (and now likely extinct) genotype *Pyrgulopsis nevadensis* occurred in Walker and Pyramid Lakes, NV.

Current distribution: Known now from 11 spring-influenced sites in Upper Klamath Lake, Klamath Co., OR (Table 3). Two sites are in Winema National Forest. Sites in Upper Klamath Lake National Wildlife Refuge (W. side of Upper Klamath Lake) are probable, as the species was confirmed to occur on the west side of the Lake in 1995. The Tule Lake population is likely extinct. Substantial range extension or increment of currently known live sites are both very unlikely, as indicated by our results to date.

Threats: Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified, as spring influence no longer compensates for the lake's general condition. Even in the best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate. To date there is little reason to expect that many more sites will be found, judging from survey results thus far.

Recommended status: Currently has none. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (OR) Endangered, as also recommended by Frest & Johannes (1993b, 1995a, 1996a). The species lives only in the limited areas of the lake not completely affected by eutropification, as they have considerable spring influx. These sites are spawning areas for three Endangered sucker species and hence may be modified as part of recovery actions for the fish.

References: Berry (1947); Hershler (1994); Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, 1992-1997.

Pyrgulopsis n. sp. 1 Klamath Lake springsnail

Figure 8; Map D10

Type locality: New species, none designated at present.

Description: This species was cited as *Pyrgulopsis* n. sp. 1 in Frest & Johannes (1993b, 1995a, d, 1996a). It is similar to the crenophile *Pyrgulopsis intermedia*, but has dark tentacles and darker body pigmentation and blunt upper whorls.

Ecology: Found on cobbles and boulders in spring-influenced areas of a large lake. It occurs with several other Species of Special Concern, namely *Lanx klamathensis*, *Pyrgulopsis archimedis*, *Pisidium ultramontanum*, *Lyogyrus* n. sp. 4, and *Vorticifex klamathensis klamathensis*, and *Vorticifex effusus dalli*. Primarily a lithophile and perilithon feeder.

Lake-dwelling (limnophile) *Pyrgulopsis* species are now somewhat unusual, though apparently widespread in the OR, CA, and NV Great Basin Plio-Pleistocene pluvial lakes. Other Western U. S. examples are *Pyrgulopsis nevadensis* and *Pyrgulopsis archimedis*; for a fossil example, see Taylor and Smith (1981).

Original distribution: Upper Klamath Lake, Klamath Co., OR. This species seems to be an Upper Klamath Lake endemic, with different ecology and morphology than the closely related *Pyrgulopsis intermedia* and another undescribed spring and stream form from NE CA.

Current distribution: Known to survive at 7 sites, all on the east side of the lake or in the Link River area (Table 3; **APPENDICES A, B, D**). One site is in Winema National Forest. Other sites are possible in the vicinity. However, it is unlikely that the range or total number of sites will be expanded greatly in the future, given recent (1990-1994) work in the Upper Klamath Basin, NE CA, and Interior Basin of OR by us and by R. Hershler *et al.*

Threats: Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified. Even in the best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species. Most sites are themselves remnants, with large areas now lacking this species due to an earlier cycle of habitat modification.

Spring sites are similarly limited; with many suitable sites lacking this taxon. Apparent restriction to the Link River and Upper Klamath Lake subaqueous springs seems evident.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate. Comprehensive survey of the Upper Klamath drainage is now underway; to date there is little reason to expect that many more sites will be found.

Recommended status: Currently has none. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (OR) Endangered, as noted also by Frest & Johannes (1995a, d, 1996a). The species lives only in the limited areas of the lake not completely affected by eutropification, as they have considerable spring influx. These sites are spawning areas for three Endangered sucker species and hence may be modified as part of recovery actions for the fish.

References: Frest & Johannes (1995a, d, 1996a); Deixis collections, 1991-1997.

***Pyrgulopsis* n. sp. 2 Lost River springsnail** = Big Spring Springsnail (per Frest 6/17/98)

Map D10

Type locality: None; to be designated when species is described.

Description: This species is a member of the *intermedia* group, typified by having penes with penial, terminal, and ventral glands only (Hershler, 1994). Details of penial morphology, shell size and shape, and female internal anatomy distinguish the species. This is perhaps the smallest member yet discovered. Cited identically in Frest & Johannes (1995a, d).

Ecology: Found in a large cold spring complex, with abundant *Rorippa*; some *Mimulus* at sides; *Chara* in deep areas; other macrophytes in impacted areas on Lost River side of complex *Ceratophyllum, Elodea, Potamogeton crispus, Potamogeton filiformis*, although the snail is rare or absent in such areas. Flow slow-moderate; substrate mud, sand, minor gravel and cobbles. This species is most common on mud substrate (is a pelophile) and appears to be a detritivore. Common associates at one site include *Fluminicola* n. sp. 8 [Lost River pebblesnail, *q.v.*], *Vorticifex* sp., and *Physella gyrina*. Other sites are spring-influenced portions of the Lost River and Sprague River with similar physiognomy and biota.

Original distribution: Probably once common in the Lost River drainage. So far, this species has not been found in the rest of the Upper Klamath drainage; nor in such adjoining areas as the Goose Lake, NE CA Great Basin, and upper Pit River drainage, although related *Pyrgulopsis* species occur there, and these areas have been surveyed recently in some detail (Frest & Johannes, 1993a, 1994a, c, 1995a, d; Hershler, 1992, 1995). It does occur in limited portions of the Sprague River; but, interestingly, not the Williamson.

Current distribution: Known from a single large spring complex tributary to the Lost River, Klamath Co., OR, and possibly from another, nearby spring complex (Table 3, Appendices A, B); from several other, similar Lost River sites; and from a couple of similar Sprague River sites; total, about 13. From our survey results thus far, it is unlikely that the geographic range of this taxon will be greatly expanded by future work, nor that large numbers of additional sites will be found. Sites on Lakeview District (Klamath Falls Resource Area) BLM lands are possible.

Threats: Much of the Lost River and Sprague River receives nitrogen- and phosphorous-enriched runoff from farming, and the rivers are extensively integrated into the Upper Klamath Reclamation Project; and irrigation usage and diversion are rampant. Much of both is heavily affected by siltation, and choked with macrophyte beds. Large sections show periodic or seasonal hypoxia or anoxia and are turbid during much of the year. Flow is now very slow and reduced in volume seasonally in much of both systems. Sections affected by the factors listed above have lost much of the native mollusk fauna, which includes this species. Many of the springs in this area have been diverted, capped, or otherwise altered, to the point of not providing habitat for native mollusk species. Groundwater recharge for some springs is also nutrient-enriched, presumably from farm runoff. This species is definitely declining, in terms of both numbers and habitat area and condition.

Criteria for inclusion: Local endemic; drastic decline in habitat condition and area; possible occurrence on public lands.

Recommended status: This species has no special status at present. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. There is sufficient recently-collected information, and recent survey work, to suggest that Federal and State (OR) listing as Endangered is appropriate for this taxon, as recommended earlier by Frest & Johannes (1995a, d, 1996a).

References: Frest & Johannes (1995a, d, 1996a); Deixis collections, 1994-1997.

Vorticifex effusus dalli **(Baker, 1945) Dall rams-horn**
Figure 9; Map D11

Type locality: Klamath Falls, Klamath Co., OR [presumably, head of Link River]; holotype USNM 219747 paratypes USNM 219747.

Description: This is a large form for the genus, with few whorls, a rapidly expanding, thin, yellowish shell, flat spire, prominent regular periostracal fringes, and varices beneath each periostracal fringe. For illustrations of shell and anatomy, see Baker (1945). *Vorticifex effusa costata* (Hemphill, 1890) has periodic periostracal fringes; but these are minor; there are no varices, no "pure" populations are known to occur, and the feature is variable, suggesting that synonymy with *Vorticifex effusus* (*s.s.*) is reasonable. *Vorticifex mailliardi* (Hanna, 1924), from Eagle Lake, CA, is similar in appearance and anatomy (from preliminary studies), and also occurs in a Great Basin periphery remnant pluvial lake; if this proves so on further work, then Hanna's name would have priority. Cited in the same manner in Frest & Johannes (1995a, d, 1996a).

Note that Turgeon *et al.* (1988) use *Vorticifex effusus* for the nominate form, while Burch (1989) uses *Vorticifex effusa*. Presumably, the former represents a correction to match the masculine gender of *Vorticifex*, *vs.* the feminine *Parapholyx*. Burch (1989) notes that *Vorticifex* is based on a fossil type, while *Parapholyx* has a living type species. Granting that fossil shells can be difficult to relate to living genera, which are often anatomically based, at least in part, for the moment there appears to be no conflict, *i.e.* competing recent genera with different anatomies but vicarious shell morphology. It thus seems reasonable to place all forms in *Vorticifex*, as Burch did.

Ecology: A lithophile and perilithon feeder, found mostly on larger cobbles and boulders, in areas with some current, in a large, spring-fed lake. Macrophytes may be present at sites, but the species seems more interested in stable solid surfaces This species also appears to be a limnophile. Remaining sites are in areas with strong spring influence, although this form has not been collected from the springs themselves. It occurs with several other Species of Special Concern, namely *Lanx klamathensis*, *Pyrgulopsis* n. sp. 1, *Pyrgulopsis archimedis*, *Pisidium ultramontanum*, *Fluminicola* n. sp. 1, *Vorticifex klamathensis klamathensis*, and *Lyogyrus* n. sp. 4.

Original distribution: Upper Klamath Lake drainage; certainly Upper Klamath Lake itself, and possibly Lower Klamath Lake and Tule Lake, Klamath Co., OR, and Siskiyou and Modoc cos., CA.

Current distribution: Survives at a very few sites in Upper Klamath Lake, Klamath Co., OR. At present, we can confirm only 4 (Table 3). The more sensitive species in Tule Lake and Lower Klamath Lake are extirpated, due to "reclamation" of a large part of both and use of the remnants as sumps for irrigation runoff. Existing sites may be in Winema National Forest or other public lands. Sites in Upper Klamath Lake National Wildlife Refuge (W. side of Upper Klamath Lake) are probable. The best remaining site is in the Link River, outlet to Upper Klamath Lake. Substantial range extension or increment of currently known live sites are both very unlikely.

Threats: Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified, as spring influence no longer compensates for the lake's general condition. Even in the lake areas adjacent to best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species. The Link River site in Klamath Falls is subject to development and urbanization pressures in its own right.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate. Comprehensive survey of the Upper Klamath drainage is now underway; to date there is little reason to expect that many more sites will be found.

Recommended status: Currently has none. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (OR) Endangered, as also suggested by Frest & Johannes (1995a, d, 1996a). The species lives only in the limited areas of the lake not completely affected by eutropification, as they have considerable spring influx and/or flow. These sites are spawning areas for three Endangered sucker species and hence may be modified as part of recovery actions for the fish.

References: Baker (1945); Frest & Johannes (1995a, d, 1996a); Deixis collections, 1991-1997.

Vorticifex effusus diagonalis **(Henderson, 1929)** **lined rams-horn**

Map D11

Type locality: Crater Lake, Crater Lake National Park, Upper Klamath Lake drainage, Klamath Co., OR; holotype UCM 15940a; paratypes UCM 15940; other paratypes in UI (Baker Collection 3926).

Description: For original description, and illustrations, see Henderson (1929); see also Baker (1945). This subspecies is large and thin-shelled; the diagonal raised lines of the shell are seen occasionally on individuals of other subspecies, but are not universal, as here. Cited under the same name in Frest & Johannes (1995a, d, 1996a).

Ecology: This form lives in spring-fed lakes and limnocrenes, as well as exceptionally large spring-fed creeks. Spring influence; very cold, clear, oligotrophic water; and fair depth are among the common factors; this species is effectively both a crenophile and limnophile. Macrophytes and epiphytic algae are sparse, with *Veronica* and rather scattered *Rorippa* the most frequent. Limy substrate is common, often muddy, but ranging to gravel and cobbles; the snails are restricted to hard substrate. Most sites have abundant large woody debris.

Original distribution: Crater Lake and adjoining parts of the Upper Klamath Lake drainage, NE end, Klamath Co., OR.; may have occurred in suitable habitat in other lakes and streams in the same drainage, *e.g.* Lower Klamath Lake and Tule Lake.

Current distribution: Known from a few sites in Crater Lake [Crater Lake National Park] and Upper Klamath Lake and its major tributaries (including one site in Winema National Forest and one in an Oregon State Park). With first-year survey results in, it is clear that substantial range extension or increment of currently known live sites are both very unlikely. We recognize 5 sites to date (Table 3).

Threats: Much of the lake habitat for this Upper Klamath Lake drainage endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs and spring-fed creeks peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified. Others have been capped for water supply or are heavily grazed. No Upper Klamath Lake sites are known to survive. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species.

Criteria for inclusion: Riparian associate; local endemic; occurrence on public lands; riparian associate.

Recommended status: Currently, this subspecies has no special status. It minimally should be considered a sensitive species by the National Park Service, Forest Service, BLM, Bureau of Reclamation, and other land management and wildlife agencies. Sufficient survey work has been conducted in recent years as to demonstrate that this taxon should be Federal and State (OR) Endangered, as noted also by Frest & Johannes (1995a, d, 1996a).

References: Henderson (1929); Baker (1945); Frest & Johannes (1995a, d, 1996a); Deixis collections, 1991-1997.

Vorticifex klamathensis klamathensis **(Baker, 1945)** **Klamath rams-horn**

Figures 5, 15; Map D13

Type locality: Apparently head of Link River, Klamath Falls, Upper Klamath Lake, Klamath Co., OR (Baker, 1945). holotype USNM 406024; paratypes USNM 406024, 219748.

Description: A large form, with few whorls, a shallow, rapidly expanding, nearly flat spire; reddish, thin shell, and no periostracal fringes or varices. For original description and illustrations of anatomy and shell, see Baker (1945). See also Frest & Johannes (1995b; discussion of *Vorticifex* n. sp. 1). Cited under the same name in Frest & Johannes (1993b, 1995a, d, 1996a).

Ecology: Lives on cobbles and boulders in flowing water in a spring-influenced streams and a large remnant pluvial lake. It occurs with several other Species of Special Concern, namely *Lanx klamathensis*, *Pyrgulopsis* n. sp. 1, *Pyrgulopsis archimedis*, *Pisidium ultramontanum*, *Fluminicola* n. sp. 1, *Vorticifex effusus dalli*, and *Lyogyrus* n. sp. 4. A lithophile and perilithon feeder, found mostly on larger cobbles and boulders, in areas with some current. Macrophytes may be present at sites, but the species seems more interested in stable solid surfaces This species also appears to be a limnophile. Remaining sites are in areas with strong spring influence, although this form has not been collected from the springs themselves.

Original distribution: Upper Klamath Lake drainage; certainly Upper Klamath Lake itself, and possibly Lower Klamath Lake and Tule Lake, Klamath Co., OR, and Siskiyou and Modoc cos., CA.

Current distribution: Survives at a very few sites (currently 14 confirmed sites: Table 3) in Upper Klamath Lake, Klamath Co., OR. The more sensitive species in Tule Lake and Lower Klamath Lake are extirpated, due to "reclamation" of a large part of both and use of the remnants as sumps for irrigation runoff. Existing sites may be in Winema National Forest or other public lands. Sites in Upper Klamath Lake National Wildlife Refuge (W. side of Upper Klamath Lake) are probable; sites on the west side were confirmed as extant in 1995. The best remaining site is in the Link River, outlet to Upper Klamath Lake. As the first year survey results make clear, substantial range extension or increment of currently known live sites are both very unlikely.

Threats: Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified, as spring influence no longer compensates for the lake's general condition. Even in the lake areas adjacent to best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species. The Link River site in Klamath Falls is subject to development and urbanization pressures in its own right.

Criteria for inclusion: Local endemic; occurrence on public lands; riparian associate.

Recommended status: Currently has none. It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Should be Federal and State (OR) Endangered, to repeat the recommendations of Frest & Johannes (1993b, 1995a, d, 1996a). The species lives only in the limited areas of the lake not completely affected by eutropification, as they have considerable spring influx and/or flow. These sites are spawning areas for three Endangered sucker species and hence may be modified as part of recovery actions for the fish.

References: Baker (1945); Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, 1991-1997.

Vorticifex klamathensis sinitsini **(Baker, 1945)** **Sinitsin rams-horn**

Figure 19; Map D13

Type locality: Barkley Springs, Hagelstein Park, Upper Klamath Lake, Klamath Co., OR. Holotype USNM 531029; paratypes USNM 531029; topotypes USNM 531064.

Description: For original description, anatomy, and illustrations, see Baker (1945). This subspecies is smaller, has a thicker and more globose shell, and a higher spire than the nominate form. Cited under the same name in Frest & Johannes (1993b, 1995a, d, 1996a).

Ecology: A crenophile, living in large cold springs with coarse substrate. Macrophytes present commonly may include abundant *Rorippa* and common *Mimulus* and *Veronica*. Water depth ranges from a few inches to 2 feet, flow is moderately rapid. Associated mollusks include *Fluminicola* spp. and *Lanx klamathensis*. This taxon is a lithophile and perilithon grazer.

Original distribution: Known at present only from a single site; and possibly from two others (Table 3), as above (in only one spring complex). Likely to occur in other springs in the same region, although large numbers of new sites are precluded by recent surveys.

Current distribution: See above. We recognize this taxon at 19 sites, most of which are in Hagelstein Park; but a few other NE-end spring sites also may have this taxon. As indicated by first-year survey results, substantial range extension or increment of currently known live sites are both very unlikely.

Threats: Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified, as spring influence no longer compensates for the lake's general condition. Even in the lake areas adjacent to best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. The single definite remaining site is threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species.

Criteria for inclusion: Local endemic; probable occurrence on adjoining public lands (Winema National Forest, Upper Klamath Lake National Wildlife Refuge); riparian associate. The spring is being modified currently to enhance listed fish species' spawning habitat.

Recommended status: This taxon has no special status at present; but was recently made a ROD species (ROD, 1994). Minimally, it should be considered a sensitive species by the Forest Service, BLM, Bureau of Reclamation, and other relevant federal and state land management and wildlife agencies. Sufficient recent survey work has been done to show that it should probably be considered Endangered both by the federal government and by OR, as also stated by Frest & Johannes (1993b, 1995a, d, 1996a).

References: Baker (1945); Frest & Johannes (1993b, 1995a, d, 1996a); ROD (1994); Deixis collections, 1991-1997.

FRESHWATER BIVALVES

Anodonta californiensis Lea, 1852 California floater

Type locality: '"Rio Colorado," actually a former distributary of the river, approximately New River, Imperial County, California. " (Taylor, 1981, p. 142).

Description: For best description and illustrations, see Burch (1973, 1975b). This form does not closely resemble other described western anodontids, except for *Anodonta wahlametensis* [*q.v.*]. That species has a much more conspicuous wing and different beak sculpture. This species has been confused in the literature with *Anodonta nuttalliana nuttalliana* and with *Anodonta nuttalliana idahoensis*. The best treatment is that of Taylor (1977, *unpub.*; 1981), who regards *Anodonta nuttalliana nuttalliana* as a synonym of *Anodonta wahlametensis* and *Anodonta nuttalliana idahoensis* as a synonym of *Anodonta californiensis.* It should be noted that the lectotype of *Anodonta nuttalliana idahoensis* was fixed by Johnson & Baker (1973), according to ICZN (1985), Article 74 b, c; and treatment of type material by Coan & Roth (1987, p. 324) is thus incorrect. As noted by Taylor (1981), there is some chance that *Anodonta californiensis* is a composite species; this needs to be carefully studied. One implication would be that protection is more justified, in that all component taxa would have limited ranges, and the whole group is already known to have been much reduced in range and abundance. This species was cited also in Frest & Johannes (1991b, 1993b, 1995a, d, 1996a).

Ecology: "Lakes and slow rivers" (Taylor, 1981, p. 142), generally on soft substrates (mud-sand), in fairly large streams and lakes only, in relatively slow current. A low elevation species, found in both lakes and lake-like stream environments; basically a limnophile. A filter-feeder, as are all unionaceans. The host fish for the glochidial stage of this bivalve is (are?) unknown; note that the fate of the fish larval host(s) also limits and determines the distribution of this species.

Original distribution: Lower Willamette and lower Columbia rivers in OR and WA from The Dalles to the mouth. In larger slow streams of northern CA as far south as the northern San Joaquin Valley. The former range includes Wahkiakum, Cowlitz, Clark, Skamania, and Klickitat cos., WA; Clatsop, Columbia, Multnomah, Hood River, and Wasco cos., OR; and Siskiyou, Shasta, Lassen, Modoc, and Tehama cos., CA.

Current distribution: Taylor (1981) reports that this species is probably eradicated over much of its original range. We have not found living specimens in the Willamette and lower Columbia River in searches from 1988-1990. Still survives in the Fall River and Pit River, Shasta Co., CA (see Frest & Johannes, 1995b); some possible specimens collected by USFWS near The Dalles, 1990. Apparently extinct in the upper Sacramento River. Also survives in the Okanogan River, Chelan Co., WA, Parts of Roosevelt Lake, Ferry Co., WA (*pers. comm.*, T. Burke, 1994), and Curlew Lake, Ferry Co., WA. This species was likely heavily impacted by the BPA dams and impoundments; see comments under *Physella columbiana.* Of the nearly 500 Columbia Basin sites surveyed by Frest & Neitzel (in press a, b; see also Neitzel & Frest, 1993), only three had live or recently dead specimens of this species. It is clearly declining in numbers and in area occupied throughout its range. The species appears to be extinct or nearly extinct in UT and NV (see, *e.g.*, Clarke & Hovingh, 1993) and is very limited in distribution in AZ. The middle Snake River populations are much circumscribed, but may be the best extant (Frest, 1992).

Locally, we can confirm only a single site as yet (Table 3).

Threats: Extensive diversion of CA rivers for irrigation, hydroelectric, and water supply projects has much reduced the CA range of this species. This species can tolerate some water pollution; but not heavy nutrient enhancement or similar problems.

Much of the middle Snake River in ID is rapidly becoming eutropified, due to agricultural runoff, trout farms, and urbanization along the river corridor. Much of the river is impounded behind a series of small dams; this is also detrimental for cold-water species such as this taxon.

The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. A recent (1994) landslide impacted some of the historic sites. Introduction of exotic mollusk species (Bowler, 1990) may also be a factor in the species' decline. Springs in this area have been impacted by ground water pollution from agricultural and dairy operations; diverted into irrigation systems; capped and diverted for stock, domestic, industrial, and piscicultural water supply; heavily grazed; and dried due to groundwater drawdown.

In the lower Columbia River region threats include impoundments; continued siltation and other impacts on the few remaining sites with habitat characteristics approximating pre-impoundment conditions on the lower Columbia. Harbor and channel "improvements" in the vicinity of Portland, The Dalles, and John Day Dam; nutrient enrichment of the lower Columbia due to agricultural run off. The Lower Granite Reservoir, WA population noted by Frest & Johannes (1992b) appears to have been extirpated by the 1992 drawdown. Declines in numbers and/or distribution of the fish host(s) may also be involved.

This taxon is declining, in terms of area occupied and number of sites and individuals.

Criteria for inclusion: Current C2 Federal candidate; occurrence on public lands; affected by federal projects; current and ongoing threats.

Recommended status: Currently this species is a C2 candidate (USFWS, 1994a). It minimally should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to demonstrate that this species should be Federal and State (OR, ID, WA, AZ, UT, WY, and CA) Threatened, as suggested previously in Frest & Johannes (1993a, b; 1995a,d; 1996a).

References: Burch (1973, 1975b); Taylor (1981); Frest (1992); Frest & Johannes, 1992b; 1993a, 1993b; 1995a, d; 1996a; Neitzel & Frest (1993); Frest & Neitzel (in press a, b); Deixis collections, 1988-1995.

Anodonta wahlametensis **Lea, 1838** **Willamette floater**

Type locality: Near the mouth of the Willamette River, Multnomah Co., OR.

Description: The best treatment of this species is in Burch (1973, 1975b). Most closely similar in shell characters is *Anodonta californiensis*; but that species is much less strongly alate and has very different beak sculpture. Literature treatments of alate western *Anodonta* species vary; we prefer to follow Burch (1973, 1975b) and Taylor (1981), which are based on much first-hand field and museum collection experience. See discussion of *Anodonta californiensis*, above, for further information. Also cited in Frest & Johannes (1993b, 1995a, d, 1996a) under the same name.

Ecology: "Lakes and slow rivers" (Taylor, 1981, p. 142), generally on soft substrates (mud-sand), but also on gravel, in fairly large streams and lakes only, in relatively slow current. A low elevation filter-feeding species. This species is both an amniphile and a limnophile. The host fish for the glochidial stage of this species is (are?) unknown; note that the fate of the fish larval host(s) also limits and determines the distribution of this species.

Original distribution: Lower Willamette River, and lower Columbia River in OR and WA from The Dalles to the mouth. In larger slow streams of northern CA as far south as the northern San Joaquin Valley. The former range includes Wahkiakum, Cowlitz, Clark, Skamania, and Klickitat cos., WA; Clatsop, Columbia, Multnomah, Clackamas, Marion, Hood River, and Wasco cos., OR; and Siskiyou, Shasta, Lassen, Modoc, Tehama, Glenn, Butte, Yuba, Sutter, Yolo, and Sacramento cos., CA. Significance of this bimodal distribution pattern is discussed in Taylor (1985) and herein.

Current distribution: Taylor (1981) reports that this species is probably eradicated over much of its original range. We have not found living specimens in the Willamette and lower Columbia River in searches from 1988-1990. Not found by Tetra Tech (1991-1993, 1993) either. Still survives in the Fall River, CA (1991); one possible specimen collected by USFWS near The Dalles, 1990. Appears to be extinct in the upper Sacramento River and almost certainly in the lower Sacramento as well (Frest & Johannes, 1993b, e, 1994a, 1995a, b). The lower Columbia populations were likely essentially extirpated by the construction and continued operation of the BPA dams and impoundments; see further comments under *Physella columbiana*. Could survive locally in deep pools with oxygenated substrate; we have no definite sites here as yet.

Threats: Extensive diversion of CA rivers for irrigation, hydroelectric, and water supply projects has much reduced the CA range of this species. In the lower Columbia River region threats include impoundments; continued siltation and other impacts on the few remaining sites with habitat characteristics approximating pre-impoundment conditions on the lower Columbia. Harbor and channel "improvements" in the vicinity of Portland, The Dalles, and John Day Dam; nutrient enrichment of the lower Columbia due to agricultural run off. Decline in numbers and/or distribution of the glochidial host(s) could also be a factor. This taxon is declining, in terms of area occupied and number of sites and individuals.

Criteria for inclusion: Local endemic; possible occurrence on public lands; considerable reduction in range and loss of historic sites; effects of federal projects on habitat; continued and ongoing threats.

Recommended status: At present, this species has no special status. It minimally should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Sufficient recent survey work has been done to indicate that this species should be Federal and State (OR, WA, and CA) Endangered, as also recommended by Frest & Johannes (1991b, 1993b, 1995a, b, c, 1996a).

References: Burch (1973, 1975b); Taylor (1981); Frest & Johannes (1991b, 1993b, 1995a-d, 1996a); Deixis collections, 1988-1995.

Pisidium (Cyclocalyx) ultramontanum **Prime, 1865** **montane peaclam**

Figure 22; Map D16

Type locality: "Canoe Creek (now Hat Creek), probably at Rising River, Shasta County, California" (Taylor, 1981, p. 146).

Description: See Burch (1972, 1975a) for description and illustrations. No other North American sphaeriid closely resembles this taxon. Cited under the same name in Frest & Johannes (1993b, 1995a, 1996a).

Ecology: Generally found on sand-gravel substrate in spring-influenced streams and lakes, and occasionally in limnocrenes; characteristically in areas with high mollusk diversity. Associates often include other Species of Special Concern, such as *Lanx klamathensis*, *Helisoma newberryi*, *Pyrgulopsis archimedis*, *Fluminicola* n. sp. 1, and *Lyogyrus* spp. This species is effectively both a crenophile and limnophile.

Original distribution: Periphery of the Great Basin in OR to Klamath River and Pit River, OR-CA, as well as some of the larger lakes (Upper Klamath Lake, Tule Lake, Eagle Lake, possibly Lower Klamath Lake), Klamath Co., OR and Siskiyou, Lassen, and Modoc cos., CA.

Current distribution: Some populations are extinct, including those in the Tule Lake and Lower Klamath Lake areas. Known to survive in the Upper Klamath Lake area (including sites in Winema National Forest and Upper Klamath National Wildlife Refuge), the middle Pit River (Frest & Johannes, 1993b, 1994a, 1995a, b), and at Eagle Lake (Lassen National Forest). Sites may exist in Shasta National Forest also, although old sites there appear to be extinct. The species is definitely declining in number of sites, range, and numbers.

We can confirm survival of this species at 6 sites in the Upper Klamath Lake drainage, including one on the west side (Table 3). Surprisingly, we have not found it as yet in more than one of the large nasmodes tributary to the Lake proper, even though it lives in similar habitat in the Upper Sacramento system.

Threats: Best remaining populations are in the Upper Klamath Lake area. Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified, as spring influence no longer compensates for the lake's general condition. Even in the lake areas adjacent to best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species. The Link River site in Klamath Falls is subject to development and urbanization pressures in its own right. Klamath River sites may now be extinct, due to impoundment and water pollution. Great Basin populations in general occur(ed) in large spring pools (limnocrenes). Overpumping of ground water; grazing; diversion and capping of springs for stock, industrial, and domestic water supply; and geothermal development are problems for these populations.

Criteria for inclusion: Local endemic; federal listing candidate; occurrence on public lands; riparian associate.

Recommended status: Currently a C2 candidate (USFWS, 1994). Otherwise, has no special protected status; minimally, the Forest Service, BLM, and other appropriate land and wildlife agencies should consider this a sensitive species. It should be considered Endangered in CA, OR, and federally, as stated previously (Frest & Johannes, 1993b, 1995a, b, d, 1996a).

References: Taylor (1981, 1985); Frest & Johannes (1993b, 1994, 1995a, b, d, 1996a); Deixis collections, 1991-1997.

Pisidium (C.) n. sp. 1 Modoc peaclam

Figure 21; Map D15

Type locality: None designated as yet; undescribed taxon.

Description: None available at present. The only literature reference is Taylor & Bright (1987), as "Modoc Plateau *Pisidium*".

Ecology: Found only in relatively large, spring-influenced streams and lakes, characteristically in areas with high mollusk diversity. Associates may include other Species of Special Concern, such as *Lanx klamathensis*, *Helisoma newberryi*, *Pyrgulopsis archimedis*, *Fluminicola* n. sp. 1, and *Lyogyrus* spp. This species is effectively both an amniphile and limnophile, with spring influence apparently also a *desideratum*.

Original distribution: Upper Klamath Lake drainage in OR to Klamath River and middle-upper Pit River, OR-CA, Klamath Co., OR and Siskiyou, Shasta, and Modoc cos., CA. The fossil record extends across southern OR (OR Interior Basins) to SE ID (Taylor & Bright, 1987, fig. 6).

Current distribution: There are six historic populations, mostly on the Modoc Plateau (Taylor & Bright, 1987, fig. 6). Some populations are extinct, including some or all of those in the Klamath River and Pit River. Known to survive in the Upper Klamath Lake area (possibly including sites in Winema National Forest and Upper Klamath National Wildlife Refuge) and possibly in the middle or upper Pit River. The species is definitely declining in number of sites, range, and numbers.

We can at present confirm survival of 3 Upper Klamath Lake drainage populations (Table 3).

Threats: Best remaining populations may be in the Upper Klamath Lake area. Much of the lake habitat for this Upper Klamath Lake endemic is considerably eutropified, has soft substrate, or both; the species is absent from such areas. Most of the large springs peripheral to Upper Klamath Lake were modified for log transport and are now part of irrigation projects; the species is absent from most areas so modified, as spring influence no longer compensates for the lake's general condition. Even in the lake areas adjacent to best remaining spring pools and spring-fed creeks feeding into the lake, the species seems to be confined to limited areas with the best water quality. Remaining sites are threatened by eutropification, urban, agricultural, and industrial pollution, and habitat modification to accommodate Endangered sucker species. The Link River site in Klamath Falls is subject to development and urbanization pressures in its own right. Klamath River and some or all Pit River sites may now be extinct, due to impoundment and water pollution. Great Basin populations in general presumably occurred in large river environments. Overpumping of ground water; grazing; diversion and capping of springs for stock, industrial, and domestic water supply; and geothermal development are problems for populations in this area, if any remain.

Criteria for inclusion: Local endemic; occurrence on public lands; continued threats to very specialized habitat.

Recommended status: Currently this undescribed form has no status. Minimally, it should be considered sensitive by the Forest Service, BLM, and other appropriate federal and state wildlife and land management agencies. Sufficient recent survey work has been done in the species' known current and fossil range (*e.g.* Frest & Johannes, 1993a, 1994, 1995a; see also various Snake River surveys by Frest & Johannes and others, summarized in USFWS, 1993) to establish that this taxon should be considered Endangered in CA, OR, and federally. We made the same recommendation in Frest & Johannes (1993b, 1995a, d, 1996a).

References: Taylor & Bright (1987); Frest & Johannes (1993b; 1995a, d; 1996a Deixis collections, 1991-1997.

Monadenia (Monadenia) n. sp. 1 **Modoc Rim sideband**

Type locality: None designated as yet; undescribed taxon.

Description: This comparatively small *Monadenia* species has a shell shape much like that of *Monadenia fidelis fidelis*. It is typically about 40% smaller (to 20 mm at 6 -6 1/2 whorls) but has an equal- or slightly larger sized umbilicus (proportionately much wider). The upper surface is generally a dirty yellow, with coarse and irregular radial growth lines and spotty spiral striation. Banding is well-developed; the base and peripheral band are dark brown.

Ecology: Restricted to large-scale dry and open vesicular basalt taluses at lower elevations. Commonly, taluses with this species have accompanying seeps or springs, and snail colonies are found mostly near talus base, *i.e.* close to the lake. Plants associated include *Urtica*, *Clematis*, *Sorbus*, *Prunus*, and *Celtus*. Surrounding plant community is sage scrub. Few other land snails co-occur. A xerophile species.

Original distribution: Probably once common on both sides of Upper Klamath Lake (Pilsbry, 1939).

Current distribution: A few colonies at the SE end of Upper Klamath Lake, Klamath Co., OR, including sites on Winema National Forest lands. We have been able thus far to locate a single surviving colony on the west side of Upper Klamath Lake, also (1997). The species appears to be declining in areas occupied and numbers, due to a combination of human modification of habitat and extended dry periods in its area of occurrence.

Threats: Talus mining and quarrying in vicinity of remaining sites; road building and road and railroad track (Burlington Northern) maintenance along the US 97 and OR 140 corridors; roadside and trackside spraying for weed control. This area has suffered recent rock slides (1993, 1994); proposed measures to alleviate that problem may eliminate colonies.

Criteria for inclusion: Local endemic; occurrence on public lands; ongoing threats. Population trends (number of sites, number of individuals) are downward. It is unlikely that many additional sites will be found.

Recommended status: At the present time this species has no special status; it should be considered a sensitive species by the Forest Service and BLM. Federal and State (OR) listing as Endangered is appropriate, due to specialized habitat and obvious threats to that habitat, as well as recent habitat loss. We made the same recommendation in Frest & Johannes (1995a, b, 1996a).

References: Pilsbry (1939); Frest & Johannes (1993b, 1995a, b, 1996a); Deixis collections, 1991-1997.

Pristiloma (Pristinopsis) arcticum? crateris **Pilsbry, 1946** **Crater Lake tightcoil**

Type locality: One mile south of Crater Lake, Klamath Co., OR; holotype ANSP 147788a; paratypes ANSP 147788; other paratypes should be in UCM collections; but not listed by Wu & Brandauer (1982).

Description: See Pilsbry (1946) for best description and illustration; this is the undescribed species referred to by Henderson (1929). Taxonomy follows Riedel (1980). The anatomy is unknown. This taxon was referred to as *Pristiloma arcticum crateris* Pilsbry, 1946 in Frest & Johannes (1993b) and as above in Frest & Johannes (1993b, 1995a, d, 1996a).

Ecology: Uncertain. Related species found at high elevations live along small streams, in leaf litter in forest, near the edges of seeps or bogs, and under cushion plants in open mountain meadows. Persistence of moisture for a good part of the year is a *desideratum*.

Original distribution: A single site in Crater Lake National Park, Klamath Co., OR.

Current distribution: Uncertain; has not been recollected recently. Occurrence in adjoining portions of Umpqua and Winema National Forests, including areas considered for protection of the Northern Spotted Owl, is possible.

We have recently recollected this species at prhaps 3 sites, one on the west side of Crater Lake (Rogue River National Forest; and two in the northern portions of the UKL drainage.

Threats: Uncertain; most of the area surrounding Crater Lake National Park have been logged and are currently being grazed, as are areas below the Park in Winema National Forest. Much of the area has been logged; and the moist, riparian areas seemingly preferred by this taxon are often ditched or modified for agriculture.

Criteria for inclusion: Local endemic; occurrence on public lands.

Recommended status: This species has no special status at present, although it was cited as a ROD species (ROD, 1994). It was recommended as a listing candidate by Frest & Johannes (1993c, 1995a, d, 1996a). At the least, it should be considered a sensitive species by the Forest Service, BLM, National Park Service, and other land management and wildlife agencies. Federal and State (OR) listing as Threatened is appropriate for the reasons just cited.

References: Henderson (1929); Pilsbry (1946); Frest & Johannes (1993b, 1995a, d, 1996a); Deixis collections, . 1995-1997.

Prophysaon coeruleum **Cockerell, 1890** **blue-gray tail-dropper**

Type locality: Olympia, Thurston County, Washington; paratypes ANSP 63913.

Description: See Pilsbry (1948, p. 692, fig. 377b; p. 693, fig. 378) for best description and illustration. Slug medium in size, to about 45 mm length; body blue to blue-gray; sole white; head slightly lighter in color, tentacles slightly darker. Dorsal and mantle markings indistinct; no posterior dorsal streak; mantle narrow, length almost 1/3 total body length; pneumostome small, anterior, almost central. Dorsal furrows weak, numerous; longitudinal furrows deep and numerous, somewhat irregular; mantle and body finely granulate; dorsal constriction usually not present. Mucus colorless, not exceptionally sticky.

Discussion: See also key to described *Prophysaon* species, **Appendix A**, key 10, of Frest & Johannes (1998, in press). One unusual feature of this taxon and the Klamath tail-dropper (*q.v.*) is that the longitudinal furrows are much less oblique than in most other *Prophysaon*, giving the posterior dorsal portion of the body an almost fingerprint-like pattern.

Ecology: This small taxon is found in relatively undisturbed, moist coniferous forest, from low to middle elevations; but also occurs at higher elevations (to subalpine), there often in semi-exposed areas such as rock piles. It is found occasionally in rock talus at lower elevations. Populations appear relatively sparse at any given site. Most often found at rather moist sites with high land snail and slug diversity at middle to higher elevations. This taxon is quite uncommon over most of its range but seems more frequent in southwestern Oregon, where it is found in a variety of forested habitats.

Original distribution: Willamette River Valley, Oregon to Olympia, Washington; Benton, Clackamas, and Multnomah counties, Oregon; Thurston and King counties, Washington. The following literature records are believed valid, although we have not necessarily examined the specimens involved: Pilsbry (1948; **Washington**: Olympia, Thurston County, Seattle, King County; **Oregon**: Portland, Multnomah County; Lake Oswego [the town], Clackamas County); Branson & Branson (1984: sites 59, 60, 63, 75, 76, 81). The species' currently known range extends from Josephine, Jackson, and Douglas counties (Rogue and Umpqua drainages) and Lane County (Willamette River valley), Oregon to King County, Washington and should not be stated as "Puget trough", as done in J2 (1994, p. 352). Based on recent (1995) finds, there is a possibility that the range of this species may extend as far east as Upper Klamath Lake and potentially along the eastern flank of the Cascades in Washington and Oregon.

Current distribution: Not found recently by Branson (1977, 1980); most of the previously recorded sites are now in urban areas. Recent live sites collected by us are in Jefferson and Lewis counties, Washington. We also have recent material from Skamania County, Washington and Jackson, Josephine, and Douglas counties, Oregon and have examined specimens from Lane County Oregon. For additional recent records, see Applegarth (1995) and comments provided by T. Burke. This taxon appears relatively common in southwestern Oregon but rare elsewhere. Its absence from immediately adjoining northwestern California is puzzling.

Not yet confirmed for the UKL drainage, where it is in part replaced by the Klamath tail-dropper (*q.v.*). However, it is likely to occur in portions of the western part of the drainage.

Threats: Logging and agricultural expansion in almost all of the known range; locally [Multnomah and Clackamas counties, Oregon; King and Thurston counties, Washington], grazing and urbanization, which has extirpated most historic sites.

Criteria for inclusion: Old growth and riparian associate; massive habitat loss.

Recommended status: Currently, a ROD Survey and Manage species (ROD, 1994). Should minimally be considered Sensitive by Forest Service, BLM, and other appropriate federal and state land management agencies; probably should be a ROD Riparian Reserve species as well. Currently (ONHP, 1995) an Oregon Natural Heritage Program list 2 species (imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences); also a ROD taxon (ROD, 1994). Should probably be considered Threatened Federally and in both Washington and Oregon, as suggested in Frest & Johannes (1993b).

References: Pilsbry (1948); Frest & Johannes (1993b); ROD (1994); Applegarth (1995); Deixis collections, 1988-1997.

Prophysaon dubium Cockerell, 1890 papillose tail-dropper

Type locality: Olympia, Thurston County, Washington; holotype ANSP 109421.

Description: See Cockerell (1890) and Pilsbry (1948) for best descriptions and illustrations. Also consult key to *Prophysaon* species, **Appendix A**, key 10. This small, compact taxon often has dark pinkish-brown or purplish-brown groundcolor with irregular darkish (black) patches around the moderately prominent tubercles, which cover both the mantle and upper tail surface. There is no posterior dorsal streak; dorsal furrows weak, numerous; longitudinal furrows deep, distinct, relatively few, regular, sometimes thinly outlined with black pigment; mantle and body distinctly tuberculate; dorsal constriction (abscission zone) usually present. Mucus colorless, not exceptionally sticky. Younger specimens often have very dark groundcolor and appear nearly black and distinctly papillate in the field.

Discussion: A very distinctive taxon not readily confused with any other. Known for some time from western Washington and western Oregon (Cascades crest to the Coast); but extended into the eastern Cascades (T. Burke, pers. comm., 1995) and northern California (Roth & Pressley, 1983) fairly recently.

Ecology: See last species. "Habitat includes a rockslide with light brush cover and the edge of a mountain meadow within a few feet of a stream." (Roth, 1993, p. 26). Like *P. coeruleum*, this species often occurs rather sparsely and is often found in partly open sites, such as forest openings or roads through relatively mature forest. It may not range as high into subalpine areas as *coeruleum*; but like the latter, can occur in rock piles. Most often found at sites with high land snail and slug diversity. Many sites are in mature forest with at least a minor deciduous component, *e.g.*, bigleaf or vine maple. Dense populations, such as seen with *P. andersoni*, *vanattae*, or *foliolatum*, are almost unheard of with this taxon and with *P. coeruleum*.

Original distribution: Four sites in northern Oregon and southwestern Washington: Pierce and Thurston counties, Washington; Hood River County, Oregon; Trinity County, California; one site in Trinity National Forest.

Current distribution: Was not collected by Branson (1977, 1980), in Washington and Oregon; collected in California (Roth and Pressley, 1983); recent sites collected by us are from Jefferson, Skamania, and Lewis counties, Washington, and Josephine, Jackson and Douglas counties, Oregon; other recent sites collected by T. Burke in Lewis and Kittitas counties, Washington. This taxon appears to be rare through most of its range but rather more common in southwestern Oregon.

We have not yet found this taxon in the UKL drainage; but there is a high probability of occurrence, as it has been confirmed recently (1997) from the upper parts of the Rogue and Umpqua drainages.

Criteria for inclusion: Old growth and riparian associate; occurrence on public lands.

Recommended status: Currently, a ROD Survey and Manage and Riparian Reserve species (ROD, 1994). Should minimally be considered Sensitive by Forest Service, BLM, and other appropriate federal and state land management agencies. Also presently (ONHP, 1995) an Oregon Natural Heritage Program list 2 species (imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences). On available evidence should be listed as Threatened Federally and in Washington, Oregon, and California, as suggested previously by us (Frest & Johannes, 1993b).

References: Pilsbry (1948); Roth (1993); Frest & Johannes (1993b); ROD (1994); Deixis collections, 1991-1997.

***Prophysaon* n. sp. 1 Klamath tail-dropper**

Type Locality: None designated as yet; undescribed species.

Description: A medium-sized (to 4.0 cm) species of *Prophysaon* with evenly medium-gray body; head, mantle, and tentacles unmarked, medium gray; sole slightly lighter gray; no posterior dorsal streak; mantle narrow; length about ¼ total body length; pneumostome small, distinctly anterior; dorsal furrows moderately strong, numerous; longitudinal furrows weak, numerous; mantle and body smooth; dorsal constriction present, posterior portion of body behind constriction about 1/3 total length. Mucus colorless, not exceptionally sticky.

Discussion: See key to *Prophysaon* species, **APPENDIX A**, key 1O, Frest & Johannes (1998, in press), for further comparisons. This taxon does not much resemble other described *Prophysaon* species except for *P. coeruleum*. They share such features as elongate, nearly longitudinally arranged dorsal furrows and very weak longitudinal furrows, giving the posterior dorsal body a fingerprint-like pattern when viewed from above (well illustrated in Pilsbry (1948, fig. 377b). This species is larger than *P. coeruleum*; has a dark gray, rather than white, sole; and the body is dark gray (and lacks blue and white pigment granules), rather than bluish. Details of the anatomy and furrow pattern consistently differ as well.

The range of this taxon abuts or interfingers with that of *P. coeruleum* in the upper Rogue and Umpqua drainages (eastern Jackson and Douglas counties, Oregon); so far, however, we have not found instances of sympatric occurrence.

Ecology: Found in moist open areas (floodplains and spring margins) in Ponderosa pine forest. This species is an annual taxon which occurs in *Pinus ponderosa*-Douglas fir forest openings of two sorts: spring-fed meadows with abundant sedges and grasses, *Aconitum*, bryophytes, *Spiranthes*, *Pyrola*, *Salix*, *Allium*, *Cornus stolonifera*, and similar plants; and along mountain streams, also in open, grass- and sedge- covered, seepy areas. The sites vary quite considerably in elevation; but one is a subalpine meadow. Land snail associates include *Deroceras* sp., *Vespericola "sierranus"*, and *Pristiloma arcticum? crateris*, as well as a variety of small, more widespread taxa.

Original distribution: Crest and east side of Oregon Cascades: probably south of Deschutes National Forest but including parts of Winema and Rogue River National Forest.

Current distribution: We recently collected this taxon at two sites in the Upper Klamath Lake drainage, one on mixed private-Winema National Forest lands on the northwestern side of Upper Klamath Lake, and the second near the Winema National Forest-Crater Lake National Park border. Both sites are in Klamath County, Oregon. Occurrence in Crater Lake National Park and vicinity is quite likely, as associated species (*e.g.*, *Pristiloma arcticum? crateris*) are known to be found there. Collected in 1997 in eastern Jackson County, Oregon, at several locations, both on Medford BLM and Rogue River National Forest lands. This species seems to replace *Prophysaon coeruleum* in those portions of the Cascades and Upper Klamath Lake drainages it inhabits.

Threats: Logging; grazing; construction of roads and maintenance of ski areas; development of lakes or housing and resorts; spring and riparian development. One site is partly badly grazed; the species was found in the areas not as badly grazed.

Criteria for inclusion: Riparian associate; mature forest associate; occurrence on public lands; habitat reduction and fragmentation; human impacts, past and projected, to whole of known range.

Recommended status: Currently has none. It should be considered a Sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. It should also be a ROD Survey and Manage and Riparian Reserve taxon. State (Oregon) and federal status as Endangered is likely justified, although further survey work would be helpful.

References: Deixis collections, 1995-1997.

Vespericola sierranus **(Berry, 1921)** **Siskiyou hesperian**

Type locality: Two miles north of Weed, Siskiyou Co., CA; holotype Berry 5087; paratype ANSP 130455.

Description: The best description and illustrations at present are those of Pilsbry (1940). We anticipate more thorough treatment sometime in the future by B. Roth. There is some possibility that this species is composite: in particular, the Upper Klamath Lake population has distinctive shell features. We have not yet had time to examine the anatomy of this form.

Ecology: Spring seeps, deep leaf litter along stream banks, and under debris on ground (Roth, 1993). Moist valley, ravine, gorge, or talus sites are preferred, *i.e.* low on a slope and near permanent or persistent water, but not normally subject to regular or catastrophic flooding. Persistence of moisture is a *desideratum*, and this species may occur in areas with running water or alongside streams and spring pools. It has been found on such plants as *Rorippa*, in association with other *Vespericola* species, *Prophysaon*, *Oxyloma*, and *Deroceras*. A strong notophile.

Original distribution: Broadly scattered sites in the following counties: OR, Jackson, Klamath; CA, Siskiyou, Plumas, Nevada, Placer, El Dorado (Roth, 1993).

Current distribution: Cited by Roth (1993) from about 17 localities. Among other areas, there are sites in Shasta and Trinity National Forest. Other localities apparently with this species are in Rogue River National Forest and on BLM lands (Medford District). Recently (1994-1997), a total of 4 sites were found in Klamath Co., OR (northern part of the Upper Klamath Lake drainage). Taxonomic status of material from this disjunct site needs further investigation.

Criteria for inclusion: Old growth and riparian associate; occurrence on public lands.

Recommended status: This species has no special status at present, although it was included as Sensitive in our previous yearly report (Frest & Johannes, 1996a). It should be considered a sensitive species by the Forest Service, BLM, and other land management and wildlife agencies. Federal listing as Threatened is appropriate for the reasons just cited. Note extensive recent searches by Roth, Miller, and Frest & Johannes (summarized in Roth (1993) and Frest & Johannes (1995a, d)). It was recommended for listing by Frest & Johannes (1993b, 1995a, b).

References: Pilsbry (1940); Roth (1972, 1993); Frest & Johannes (1993b, 1994a, 1995a, b, d); Deixis collections, 1991-1997.

WATCH LIST

Under this heading are discussed taxa which are known or have been reported to occur in the Interior Columbia Basin; are known to have lost much of their range; and are regarded as sensitive species, *i.e.* especially associated with mature, relatively undisturbed forests; riparian areas; springs; and/or some combination of specialized or especially impacted habitat. However, these taxa may have had a comparatively broad range originally; or may be species which currently known or thought to be common outside the area of assessment elsewhere in the US or in adjacent countries. These taxa are not regarded as in imminent danger of extinction without protection currently (although this may change rapidly, depending upon the management strategy adapted for public lands, and upon the effectiveness of its implementation).

These taxa should be regarded as sensitive by land management and wildlife planners, and their status should be carefully and periodically reviewed. Complacency in regard to their status and needs is *not* suggested.

FRESHWATER BIVALVES

***Gonidea angulata* (Lea, 1838)   western ridgemussel**

Type locality: "Lewis's River" [Snake River], Idaho; types not seen.

Description: See Burch (1973, 1975b) for best short description and illustration. This taxon is very distinctive.

Ecology: Found mostly in creeks and rivers of all sizes; rarely in lakes or reservoirs unless with substantial flow. This amniphile, filter-feeding taxon can live on firm mud substrate as well as on more coarse materials (which are more typical). More pollution-tolerant than some unionids; but still absent from highly polluted areas and places with unstable or very soft substrate. The host fish for the glochidia of this species is (are?) unknown.

Original distribution: "Southern British Columbia to southern California, eastward to southern Idaho and northern Nevada" (Taylor, 1981). It should be noted that the species had a limited distribution W. of the Cascades, particularly in WA and OR, where most sites N. of SW OR are doubtful.

Current distribution: Uncertain. Known to be extirpated from many of the old sites, including much of the Snake system; but still common in some areas. Still occurs sporadically in some major tributaries to the Columbia and Snake, such as the Okanogan River (WA) and Clearwater River, Hells Canyon, and middle Snake River (ID). Formerly in Little Granite Reservoir (Frest & Johannes, 1992c); but this population is believed to have been extirpated by the 1993 drawdown.

In the UKL drainage, we recognize 4 sites currently. The best of these is in the lower Williamson River. Other sites are in the Lost River system.

Threats: Extensive diversion of CA rivers for irrigation, hydroelectric, and water supply projects has much reduced the CA range of this species. This species can tolerate some water pollution; but not heavy nutrient enhancement or similar problems. For some recent records, see Taylor (1981), Frest & Johannes (1991a, 1992b, c, 1993b, 1994a, 1995a, b, d).

Much of the middle Snake River in ID is rapidly becoming eutropified, due to agricultural runoff, fish farms, and urbanization along the river corridor. Much of the river is impounded behind a series of small dams; this is also detrimental for cold-water species such as this taxon. The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. A recent (1994) landslide impacted some of the historic sites. For some recent ID sites for this species, see references under Frest & Johannes (in part).

In the lower Columbia River region threats include impoundments; continued siltation and other impacts on the few remaining sites with habitat characteristics approximating pre-impoundment conditions on the lower Columbia. Harbor and channel "improvements" in the vicinity of Portland, The Dalles, and John Day Dam; nutrient enrichment of the lower Columbia due to agricultural run-off.

This taxon is declining, in terms of area occupied and number of sites and individuals. Note that the fate of the fish larval host(s) also limits and determines the distribution of this species.

Criteria for inclusion: Regional endemic; loss of historic sites; human modification throughout range; concentration of human activities within preferred habitat; occurrence on public owned or regulated lands.

Recommended status: We do not recommend Federal or State (WA, OR, ID) listing as this point, although the species minimally should be considered sensitive by the BLM, Forest Service, and other appropriate land management and wildlife agencies. More survey work needs to be done on this species, particularly in OR.

References: Burch (1973, 1975b); Taylor (1981); Frest & Johannes (1991a, 1992b, c, 1994a, 1995a, b, d, 1996a); Deixis collections, 1987-1997.

***Margaritifera falcata* (Gould, 1850)** **western pearlshell**

Type locality: "Puget Sound, Oregon" [*sic*: now Washington]; holotype USNM 5893, according to Johnson (1964).

Description: For best short description and illustration see Burch (1973, 1975b). The generally purple nacre and hermaphroditic condition are distinctive as compared to *Margaritifera margaritifera*, the most closely related species. See also discussion in Taylor (1988b).

Ecology: Primarily an amniphile species; medium-sized streams are preferable, although sometimes found in streams considerably narrower than 1 m (*contra* Clarke, 1981); rarely, in lakes with stream-like conditions. Generally in fast, clear, very cold areas with coarse substrate. In undisturbed streams, this species may cover the bottom. Host fish for the glochidia include Chinook salmon, rainbow trout, brown trout, brook trout, specked dace, Lahontan redside, and Tahoe sucker (Clarke, 1981).

Original distribution: "Southern Alaska to central California, eastward to western Montana, western Wyoming, and northern Utah" (Taylor, 1981).

Current distribution: Extinct in most of the Snake system (except for upper tributaries, including the Blackfoot River (ID) and some major creeks in ID and WY); extinct from many of the coastal streams, in which it was once ubiquitous. Status of interior populations needs further work; extinct in the Okanogan River, *e.g.* many populations do not appear to have reproduced for many years. Populations persist locally in parts of the Coeur d'Alene system, including the Coeur d'Alene River and St. Maries River.

In the UKL drainage, we have so far seen this taxon live at only 3 sites. The best of these is in the lower Williamson River. Two additional sites are in the Sprague.

Threats: Extensive diversion of rivers for irrigation, hydroelectric, and water supply projects has much reduced the WA, OR, ID, and CA range of this species. This species is not as tolerant of water pollution as *Gonidea angulata* and *Anodonta kennerlyi*; heavy nutrient enhancement, siltation, unstable substrate, or similar problems extirpate populations. For some recent records, see Taylor (1981), and Frest & Johannes (1991a, 1992b, 1993e, 1994a, 1995b, d).

Much of the middle Snake River in ID is rapidly becoming eutropified, due to agricultural runoff, fish farms, and urbanization along the river corridor. Much of the river is impounded behind a series of small dams; this is also detrimental for cold-water species such as this taxon. The area has been declared water-quality limited by EPA and the State of Idaho. Fine sediment influx, generally from the same causes, is also a major problem. A recent (1994) landslide impacted some of the historic sites. For some recent ID sites for this species, see references under Frest & Johannes (in part). Conditions in the Snake are typical for many of the rivers in this species' range. We have seen no live specimens from the mainstem Snake recently.

In the lower Columbia River region threats include impoundments; continued siltation and other impacts on the few remaining sites with habitat characteristics approximating pre-impoundment conditions on the lower Columbia. Harbor and channel "improvements" in the vicinity of The Dalles and John Day Dam; nutrient enrichment of the lower Columbia due to agricultural run-off. We have seen no live specimens from the mainstem Columbia recently.

This taxon is declining, in terms of area occupied and number of sites and individuals. Note that the fate of the fish larval host(s) also limits and determines the distribution of this species.

Criteria for inclusion: Regional endemic; loss of most historic sites; human modification of habitat throughout the range; occurrence on public lands.

Recommended status: We do not recommend formal Federal or State (WA, OR, ID, MT, WY, NV, & UT) listing at this point, although the species should be considered sensitive by the BLM, Forest Service, National Park Service, and other land management, wildlife, and water regulatory agencies. Further work needs to be done to document range changes. it should be noted, however, that populations showing repeated reproduction (at least several age classes) are now the exception rather than the rule.

References: Burch (1973, 1975b); Taylor (1981);Frest & Johannes (1991a, 1992b, 1993e, 1994a, 1995b, d, 1996a); Deixis collections, 1987-1995.

EXTRALIMITAL SENSITIVE TAXA POSSIBLY IN THE PROJECT AREA

LAND SNAILS

Discus shimeki cockerelli Pilsbry, 1898 no common name

Type locality: Saguache Co., CO; ANSP 73671 (Pilsbry, 1948).

Description: See Pilsbry (1948) for description and discussion. See also Frest & Johannes (1993d).

Ecology: In Wyoming and South Dakota this species is found in a variety of habitats, ranging from streamside slope bases in rich pine and spruce forest to mountain meadows. Most sites are relatively undisturbed, shaded, and perennially moist.

Original distribution: Rocky Mountain states, according to Pilsbry (1948). Two California sites are doubtful, according to Roth (pers comm., 1994). Also reported from "east side Upper Klamath Lake" by Baker; we have thus far not seen this lot.

Current Distribution: Sporadic in the Rocky Mountain states and provinces. We have not seen it in the Upper Klamath Lake area; but have not made strenuous efforts to locate it as yet. We did not locate it in the Lower Salmon River drainage, Idaho, either (Frest & Johannes, 1995c).

Threats: Grazing and logging in the Rockies; also disturbance or destruction of riparian vegetation and of springs and seeps, partly for agricultural purposes.

Criteria for inclusion: This subspecies was until recently (USFWS, 1994) a federal C2 candidate. Status of the nominate form needs to be investigated more thoroughly, as noted by Frest & Johannes (1993d). The species is rare in South Dakota.

Recommended status: None at present; requires further investigation.

References: Pilsbry (1948); Frest & Johannes (1993d, 1995a, d, 1996a).

Fluminicola modoci Hannibal, 1912 Modoc pebblesnail

Type locality: Fletcher Spring, near SW end of Goose Lake, Modoc Co., CA. The figured type may be the specimen illustrated as *Amnicola micrococcus* in Hannibal in Keep (1911 [1910]); this may be the specimen (former SU 5777, now in CAS) designated as type by Taylor and Smith (1971); other material (paratypes) CAS 60798, 60799, 66545. The specimen illustrated by Hannibal (1912) as this species appears to be the same one illustrated as *Paludestrina longinqua* in Hannibal (1911).

Description: See Hershler & Frest (1996) for comprehensive discussion and illustration. Taylor (1966b, 1985) regarded this species as a synonym of *Fluminicola turbiniformis*; with comprehensive revision of the named *Fluminicola* species, this is not tenable. Problems remain with this taxon, in that the description and some of the type lot indicate a tall conical species, probably a *Pyrgulopsis*. The Fletcher Spring lot may contain two species of *Fluminicola*, the other of which is certainly undescribed. The revision by Hershler & Frest (1996) for the time being accepts this taxon as a valid species of *Fluminicola* with a small, moderately tall-low conical decollate spire, somewhat as in the specimen regarded by Taylor & Smith (1971) as the holotype. This is by no means certain, although such a taxon does indeed exist; and the Taylor & Smith specimen may not be the holotype.

Ecology: Found in medium-large springs; a crenocole. Sites with this species have slow-swift flow; clear, very cold water; and common *Rorippa* and *Mimulus*. Substrate varies from sand and mud to basalt cobble and boulder, with most specimens occurring in areas with coarse substrate. Other small *Fluminicola* species, *Pyrgulopsis*; *Physella*; and sphaeriids co-occur, although this species is the usual dominant.

Original distribution: Known with certainty only from springs on the W. side of Goose Lake, Modoc Co., CA. The species is included here because Goose Lake and its associated drainages extend into Lake Co., OR. We have recently collected small *Fluminicola* spp. there, which may represent this or other taxa. Such taxa have been known to occur in the OR portion of the drainage since the 1970s (D. W. Taylor, *unpub.*).

Current distribution: Currently (Hershler & Frest, 1996) known to persist only in a few springs on the SW end of Goose Lake. Some of the springs in this area are on Modoc or Fremont National Forest lands.

Threats: Springs in this area are heavily grazed, including the type locality. Many mapped springs are now dry, due to grazing, diversion, and capping for stock and domestic usage. Others have become heavily eutropified, due to integration into irrigation systems.

Criteria for inclusion: Very local endemic; occurrence on public lands; loss of populations and threats to the specialized habitat of this species.

Recommended status: This species has no special status at present. Minimally, it should be considered a sensitive species by the Forest Service, BLM, and other appropriate land management and wildlife agencies. We recommend listing as Endangered Federally and in CA (and possibly in OR as well), as we did in Frest & Johannes, 1995a, b). We are currently doing a comprehensive survey of this drainage (Frest & Johannes, 1993e, 1994, 1995b, 1996a); much of NE CA has recently been surveyed for springsnails by R. Hershler *et al.* (1990-1994).

References: Hannibal (1911, 1912); Taylor & Smith (1971);Frest & Johannes (1995a, b, 1996a); Hershler & Frest (1996); Deixis collections, 1993-1995.

GLOSSARY

amnicole (n.)	organism living only in or preferring stream environments; stream dweller.
amniphile (n.)	preferring stream environments.; **amniphilic** is the adjective.
aufwuchs (n.)	the organic coating on stones or other underwater surfaces in permanent water bodies; consists of diatoms, protozoans, small algal epiphytes; fungi; and bacteria. The major food resource for lithophile taxa, and for perilithon and periphyton feeders (*q.v.*).
calciphile (n.)	a species requiring relatively large amounts of free calcium ions for its shell or for other physiology- or metabolism-related reasons; used here for certain land snail and slug species; there are calciphile plants as well.
crenocole (n.)	organism living only in spring environments; spring dweller.
crenophile (n.)	preferring spring environments; crenophilic is the adjective.
detritivore (n.)	aqueous taxon feeding on organic particles in sediment.
edaphic (adj.)	pertaining to soil conditions, such as composition, pH, zone, etc.
epigean (adj.)	pertaining to surface, as opposed to underground, waters.
epiphyte (n.)	(small) organism living attached to a (larger) substrate particle or other organism; **epiphytic** is the adjective.
epibiont (n.)	organism (plant or animal) living attached to another organism or substrate particle
eucrenic (adj.)	well-watered; having numerous springs.
eurytopic (adj.)	of or pertaining to an organism with broad habitat tolerances.
insolation (n.)	the amount of sunlight striking the ground.
iteroparous (adj.)	capable of reproducing more than once during a lifetime
limnetic (adj.)	of or pertaining to lakes; living in lakes.
limnocole (n.)	organism restricted to or preferring lake environments; lake dweller.
limnocrene (n.)	spring pool, with or without outlet; generally used for rather large pools.
limnophile (n.)	preferring lake environments; **limnophilic** is the adjective.
nasmode (n.)	spring complex; spring family; area with a number of nearby springs originating from the same source.

nasmodic (adj.) having large numbers of springs.

notophile (n.) a species tolerant of or requiring very moist conditions for at least part of its life, such as occur alongside permanent streams, seeps or springs; used here for certain land snail and slug species. The adjective is **notophilic**.

pelophile (n.) preferring muddy environments; **pelophilic** is the adjective.

perilithon (n.) those organisms growing on stones; usually refers to the smaller (near to microscopic, and consisting of just one or a few cells per individual) and inconspicuous epiphytic algae, diatoms, protozoans, bacteria and fungi, rather than to larger organisms or plants; **aufwuchs**, in part.

periphyton (n.) those organisms growing on submerged stems and other parts of aquatic macrophytes; usually refers to the smaller (near to microscopic, and consisting of just one or a few cells per individual) and inconspicuous epiphytic algae, diatoms, protozoans, bacteria and fungi, rather than to larger organisms or plants; **aufwuchs**, in part.

phreatic (adj.) of or pertaining to groundwater crevices; living in underground waters.

regolith (n.) the parent rock from which the soil in an area is derived; or that lithology most influencing edaphic conditions.

semelparous (adj.) reproducing only once in a lifetime.

stenotherm (n.) organism having narrow temperature tolerances.

stenotopic (adj.) of or pertaining to an organism having narrow habitat tolerances.

thermicole (n.) organism living only in or preferring warm spring environments.

thermiphile (n.) preferring warm spring environments; **thermiphilic** is the adjective.

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REFERENCES

Allison, I. S. 1966. Fossil Lake, Oregon. Oregon State University, Studies in Geology 8. 48 pp.

Applegarth, J. S. 1995. Invertebrates of Special Status or Special Concern in the Eugene District. USDI Bureau of Land Management, Eugene Oregon. 126 pp.

Baker, F. C. 1945. *The Molluscan Family Planorbidae.* University of Illinois Press, Urbana, Illinois, 530 pp.

Baker, H. B. 1925. Anatomy of *Lanx*, a limpet-like lymnaeid mollusk. Proceedings, California Academy of Sciences 14: 143-169

Benke, A. C. 1990. A Perspective on America's Vanishing Streams. North American Benthological Society 9: 77-88.

Berry, S. S. 1947. A new *Pyrgulopsis* from Oregon. The Nautilus 60: 76-78.

Binney, A. 1865. Land and fresh water shells of North America. Parts II. and III. Smithsonian Miscellaneous Collections, 7(2), i-ix, 1-161; 7(3), i-viii, 1-120.

Boss, K. J. 1978.On the evolution of gastropods in ancient lakes, pp. 385-428. *In* V. Fretter & J. Peake (eds.), *The Pulmonates. Volume 2A. Systematics, Evolution and Ecology.* Academic Press, Orlando, Florida.

Bowler, P. B. 1990. The rapid spread of *Potamopyrgus antipodarum* (Gray) in the middle Snake River, Idaho. Proceedings of the Desert Fishes Council 21: 173-182.

Branson, B. A. 1977. Freshwater and Terrestrial Mollusca of the Olympic Peninsula, Washington. The Veliger 19: 310-330.

------------------. 1980. Collections of gastropods from the Cascade Mountains of Washington. The Veliger 23: 171-176.

-----------------, & R. M. Branson. 1984. Distributional Records for Terrestrial and Freshwater Mollusca of the Cascade and Coast Ranges, Oregon. The Veliger 26: 248-257.

Brown, K. M. 1991. Mollusca: Gastropoda, pp. 285-314. In Thorp, J. & A. Covich (eds.). 1991. *Ecology and Classification of North American Freshwater Invertebrates.* Academic Press. 911 pp.

Burch, J. 1972. *Freshwater Sphaeriacean clams of North America.* US EPA, Water Poll. Control Res. Ser., 18050 ELDO3/72 [Biota of Freshwater Ecosys. Iden. Man. 3], viii + 31 pp.

------------. 1973. *Freshwater Unionacean clams (Mollusca: Pelecypoda) of North America.* U.S. EPA, Water Poll. Control Res. Ser., 18050 ELDO3/73 [Biota of Freshwater Ecosys. Iden. Man. 11], xi + 176 pp.

------------. 1975a. *Freshwater Sphaeriacean Clams (Mollusca: Pelecypoda) of North America.* Malacological Publications, Hamburg, MI. xi + 96 pp.

------------. 1975b. *Freshwater Unionacean Clams (Mollusca: Pelecypoda) of North America.* Malacological Publications, Hamburg, MI. xviii + 206 pp.

------------. 1982a. *Freshwater Snails (Mollusca: Gastropoda) of North America.* Environ. Monitor. Supp. Lab., Office Res. & Devel., U.S. EPA, Cincinnati. EPA-600/3-82-026. vi + 294 pp.

-----------. 1982b. North American freshwater snails. Trans. POETS Soc. 1 (4): 216-365.

-----------. 1983. North American freshwater snails. Trans. POETS Soc. 1(6): 1-80.

-----------. 1989. *North American Freshwater Snails.* Malacological Publications, Hamburg, MI. viii + 365 pp.

-----------, & J. Tottenham. 1980. North American freshwater snails. Trans. POETS Soc. 1 (3): 81-215.

Clarke, A. H. 1973. The Freshwater Molluscs of the Canadian Interior Basin. Malacologia 13: 1-509.

----------------. 1981. *The Freshwater Molluscs of Canada.* National Museum of Natural Sciences, National Museums of Canada. 446 pp.

----------------, & P. Hovingh. 1993. Status Survey of Fifteen Species and Subspecies of Aquatic and Terrestrial Mollusks from Utah, Colorado, and Montana. Final Report, Contract #14-16-0006-91-046, USDI Fish & Wildlife Service. Ecosearch, Inc., Portland Texas. 77 pp. + appendices.

Clench, W. J. 1940. *Pyrgulopsis nevadensis* Stearns in Oregon. The Nautilus 53: 137.

Coan, E. & B. Roth 1987. The malacological taxa of Henry Hemphill. The Veliger 29: 322-339.

Cockerell, T. D. A. 1890. New Western Slugs. The Nautilus 3: 111-113.

Coutant, C. C. & C. D. Becker. 1970. Growth of the Columbia River limpet, Fisherola nuttalli (Haldeman), in normal and reactor-warmed water. Battelle Pacific Northwest Laboratory BNWL-1537. 34 pp.

Crawford, R. 1983. Grid system for recording specimen collection localities in North America. Sys. Zool. 32: 389-402.

Davis, G. M. 1969. The origin and evolution of the gastropod family Pomatiopsidae, with emphasis on the Mekong River Triculinae. Academy of Natural Sciences of Philadelphia, Monographs, 20, 120 pp.

FEMAT, 1993. Forest Ecosystem Management. An Ecological, Economic, and Social Assessment. U. S. Department of Agriculture, Forest Service, Portland, Oregon. xi + 731 pp., appendices.

Frest, T. 1992. Mollusc Fauna in the Vicinity of Three Proposed Hydroelectric Projects on the Middle Snake River, Central Idaho. Supplemental Report on the California floater

Anodonta californiensis Lea, 1852. Final Report to Don Chapman Consultants, Inc., Boise, Idaho. Deixis Consultants, Seattle, Washington. 4 pp.

------------, & P. Bowler. 1993. A Preliminary Checklist of the Aquatic and Terrestrial Mollusks of the Middle Snake River Sub-Basin. Proc. Desert Fishes Council 24: 53-58.

-----------, & E. J. Johannes. 1991a. Mollusc Fauna in the Vicinity of Three Proposed Hydroelectric Projects on the Middle Snake River, Central Idaho. Deixis Consultants, Seattle, Washington. 60 pp.

----------------------------------. 1991b. Present and potential candidate molluscs occurring within the range of the Northern Spotted Owl. Deixis Consultants, Seattle, Washington. 30 pp.

----------------------------------. 1992a. Mollusc Fauna in the Vicinity of Three Proposed Hydroelectric Projects on the Middle Snake River, Central Idaho. Supplemental Report on the California floater *Anodonta californiensis* Lea, 1852. Deixis Consultants, Seattle, Washington. 4 pp.

----------------------------------. 1992b. Distribution and Ecology of the Endemic and Relict Mollusc Fauna of Idaho TNC's Thousand Springs Preserve. Deixis Consultants, Seattle, Washington. ii + 291 pp.

----------------------------------. 1992c. Effects of the March, 1992 Drawdown on the Freshwater Molluscs of the Lower Granite Lake area, Snake River, SE Washington and western Idaho. Deixis Consultants, Seattle, Washington. i + 11 pp.

----------------------------------. 1993a. Freshwater Molluscs of the Upper Sacramento System, California. 1992 yearly report. Deixis Consultants, Seattle, Washington. iv + 101 pp., appendices.

----------------------------------. 1993b. Mollusc Species of Special Concern within the Range of the Northern Spotted Owl. Deixis Consultants, Seattle, Washington. iv + 98 pp.; June, 1993 addendum ii + 39 pp.

----------------------------------. 1993c. Mollusc Survey of the Auger Falls Project (FERC #4794) Reach of the Middle Snake River, Idaho. Deixis Consultants, Seattle, Washington. ii + 35 pp.

----------------------------------. 1993d. Land Snail Survey of the Black Hills National Forest, South Dakota and Wyoming. Deixis Consultants, Seattle, WA. iv + 156 pp., appendix.

----------------------------------. 1994a. Freshwater Molluscs of the Upper Sacramento System, California. 1993 yearly report. Deixis Consultants, Seattle, Washington. iv + 101 pp., appendices.

----------------------------------. 1994b. Proposal for Reintroduction of Selected Mollusc Species into the Upper Sacramento drainage. Deixis Consultants, Seattle, Washington. 29 pp.

----------------------------------. 1994c. Mollusk Survey of Tuscarora Pipeline Project Right of Way. Deixis Consultants, Seattle, Washington. 19 pp.

----------------------------------. 1994d. Mollusk Survey of the Upper Klamath Drainage. Deixis Consultants, Seattle, Washington. 78 pp. [draft]

----------------------------------. 1995a. Interior Columbia Basin Mollusk Species of Special Concern. Deixis Consultants, Seattle, Washington. xi + 361 pp.

----------------------------------. 1995b. Freshwater Molluscs of the Upper Sacramento system, California. 1994 yearly report. Deixis Consultants, Seattle, Washington. iii + 88 pp., appendices.

----------------------------------. 1995c. Land Snail Survey of the Lower Salmon River Drainage, Idaho. Final Report to USDI Bureau of Land Management. Deixis Consultants, Seattle, Washington. vii + 230 pp., appendices.

____________________. 1995d. Freshwater Mollusks of the Upper Klamath Lake Drainage, Oregon. 1994 yearly report to Oregon Natural Heritage Program. Deixis Consultants, Seattle, Washington. v + 95 pp., appendices.

----------------------------------. 1996a. Freshwater Mollusks of the Upper Klamath Drainage, Oregon. Deixis Consultants, Seattle, Washington. 219 pp.

____________________. 1996b. Additional Information on Certain Mollusk Species of Special Concern Occurring Within the Range of the Northern Spotted Owl. Report to Oregon State Office, BLM. Deixis Consultants, Seattle, Washington. vi + 150 pp.

____________________. 1997. Upper Sacramento System Freshwater Mollusk Monitoring, California. 1996 final report to Cantara Trustee Council. Deixis Consultants, Seattle, Washington. iii + 95 pp., appendices.

----------------------------------. 1998. (in press) *Northwestern US Sensitive Mollusk Species*. Deixis Consultants, Seattle, Washington.

-----------------, & D. Neitzel. [in press, a]. Notes on the distribution and biology of *Fisherola nuttalli* (Haldeman, 1843), the shortface lanx (Gastropoda: Pulmonata: Lancidae). The Veliger.

-----------------, & D. Neitzel. [in press, b]. Notes on the distribution and biology of *Fluminicola fuscus* (Haldeman, 1841), the Columbia pebblesnail (Gastropoda: Prosobranchia: Hydrobiidae). The Veliger.

FSEIS, 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. U. S. Department of Agriculture, Forest Service, Portland, Oregon. Vol. 1, xvi + 532 pp.; vol. 2, 521 pp. [appendices].

FSEIS, 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Appendix J2. Results of Additional Species Analysis. U. S. Department of Agriculture, Forest Service, Portland, Oregon. 476 pp.

Furnish, J. L. 1990. Factors affecting the growth, production and distribution of the stream snail *Juga silicula* (Gould). Unpublished Ph.D. thesis, Oregon State University, 173 pp.

Gregg, W. O. & D. W. Taylor. 1965. *Fontelicella* (Prosobranchia: Hydrobiidae), a new genus of west American freshwater snails. Malacologia 3: 103-110.

Hanna, G. D. 1922. Fossil freshwater mollusks from Oregon contained in the Condon Museum of the University of Oregon. University of Oregon Publications, 1(12), 22 pp.

------------------. 1930. *Pyrgulopsis nevadensis* (Stearns) in Oregon. The Nautilus 43: 1043-104.

Hannibal, H. 1911 [1910]. Shells of lakes and streams, pp. 299-318, in J. Keep, *West Coast Shells.* Whitaker and Ray-Wiggin Co., San Francisco. 346 pp.

----------------. 1912. A Synopsis of the Recent and Tertiary Freshwater Mollusca of the Califomian Province, based upon an Ontogenetic Classification. Proceedings of the Malacological Society of London 10: 112-166.

Hawkins, C. P. & J. L. Fumish. 1987. Are snails important competitors in stream ecosystems? Oikos 49: 209-220.

Henderson, J. 1924. Mollusca of Colorado, Utah, Montana, Idaho and Wyoming. University of Colorado Studies 13: 65-223.

------------------. 1929. The Non-marine Mollusca of Oregon and Washington. University of Colorado Studies 17: 47-190.

------------------. 1936a. The Mollusca of Colorado, Utah, Montana, Idaho and Wyoming. Supplement. University of Colorado Studies 23: 81--145.

------------------. 1936b. The Non-marine Mollusca of Oregon and Washington. Supplement. University of Colorado Studies 23: 251--280.

Hershler, R. 1985. Systematic revision of the Hydrobiidae (Gastropoda: Rissoacea) of the Cuatro Ciengas Basin, Coahuila, Mexico. Malacologia 26: 31-123.

---------------. 1989. Springsnails (Gastropoda: Hydrobiidae) of Owens and Amargosa River (exclusive of Ash Meadows) drainages, Death Valley system, California-Nevada. Proceedings of the Biological Society of Washington 104: 176-248.

---------------. 1992. Status survey of hydrobiid snails in the Great Basin of northern Califomia. Report for California Department of Fish & Game, 21 pp.

--------------- 1994. A Review of the North American Freshwater snail genus *Pyrgulopsis* (Hydrobiidae). Smithsonian Contributions to Zoology, 554, 121 pp.

---------------. 1995. New freshwater snails of the genus *Pyrgulopsis* (Rissooidea: Hydrobiidae) from California. The Veliger 38: 343-373.

--------------. 1998. A systematic review of the hydrobiid snails of the Great Basin, western United States. Part I. Genus *Pyrgulopsis.* The Veliger 41(1): 1-132.

--------------. in press. A systematic review of the hydrobiid snails of the Great Basin, western United States. Part II. Genera *Pristinicola*, *Colligyrus*, and *Tryonia*. The Veliger.

-------------, & T. J. Frest. 1996. A Review of the North American Freshwater Snail Genus *Fluminicola* (Hydrobiidae). Smithsonian Contributions to Zoology, 583, iii + 41 pp.

--------------, & J. J. Landeye. 1988. Arizona Hydrobiidae (Prosobranchia: Rissoacea). Smithsonian Contributions to Zoology, 459, 63 pp.

-------------, & D. W. Sada. 1987. Springsnails (Gastropoda: Hydrobiidae) of Ash Meadows, Amargosa Basin, California-Nevada. Proceedings of the Biological Society of Washington 100: 776-843.

--------------, & F. R. Thompson. 1987. North American Hydrobiidae (Gastropoda: Rissoacea): Redescription and Systematic Relationships of *Tryonia* Stimpson, 1865 and *Pyrgulopsis* Call and Pilsbry, 1886. The Nautilus 101: 25-32.

--. 1991. A review of the aquatic gastropod subfamily Cochliopinae (Prosobranchia: Hydrobiidae). Malacological Review, Supplement 5, 140 pp.

Hoeh, W. R., K. S. Frazer, E. Naranjo-Garcia, & R. J. Trdan. 1996. A phylogenetic perspectiveon the evolution of simultaneous hermaphroditism in a freshwater mussel clade (Bivalvia: Uniuonidae: *Utterbackia*). Malacological Review 28: 25-42.

Hubbs, C. L. & R. R. Miller. 1948. The Great Basin, with emphasis on glacial and post-glacial times. II. The zoological evidence: correlation between fish distribution and hydrographic history in the desert basins of western United States. University of Utah Bulletins 38 (Biol. Series 10): 1-191.

Johnson, R. I. 1964. The Recent Mollusca of Augustus Addison Gould. U. S. National Museum Bull. 239, 182 pp.

------------------, & H. B. Baker. 1973. The types of Unionacea (Mollusca: Bivalvia) in the Academy of Natural Sciences of Philadelphia. Proceedings, Academy of Natural Sciences of Philadelphia 125: 145-186.

McGinnis, S. M. 1984. *Freshwater Fishes of California*. University of California Press, 316 pp.

McMahon, R. F. 1991. Mollusca: Bivalvia, pp. 315-399. In Thorp, J. & A. Covich (eds.). 1991. *Ecology and Classification of North American Freshwater Invertebrates.* Academic Press. 911 pp.

Miller, R. R. 1959. Origin and affinities of the freshwater fish fauna of western North America, pp. 187-222. In Hubbs, C. L. (*ed.*), *Zoogeography*. American Association for the Advancement of Science Publication 51:1-509.

--------------. 1965. Quaternary freshwater fishes of North America, pp. 565-581. In H. E. Wright, jr. & D. G. Frye (*eds.*) *The Quaternary of the United States*. Princeton University Press, 922 pp.

-------------, & G. R. Smith. 1981. Distribution and evolution of *Chasmistes* (Pisces: Catostomidae) in western North America. University of Michigan Museum of Zoology Occasional Papers, 696, 46 pp.

Minkley, W. L. & J. E. Deacon (eds.). 1991. *Battle against Extinction. Native Fish Management in the American West*. University of Arizona Press, 517 pp.

------------------, D. A. Hendrickson, & C. E. Bond. 1985. Geography of western North American freshwater fishes: Description and relationships to intercontinental tectonism, pp. 519-613. In E. O. Wiley & C. H. Hocutt (*eds.*), *Zoogeography of North American Freshwater fishes*. Wiley-Interscience, 613 pp.

Moyle, P. B. 1976. *Inland Fishes of California*. University of California Press, 405 pp.

----------------, *et al.* 1982. Distribution and Ecology of Stream Fishes of the Sacramento-San Joaquin Drainage System, California. University of California Publications in Zoology 115, 256 pp.

Neitzel, D. & T. Frest. 1993. Survey of Columbia River Basin Streams for Columbia Pebblesnail *Fluminicola columbiana* and Shortface Lanx *Fisherola nuttalli.* Battelle Pacific Northwest Laboratory PNL-8229. ix + 29 pp., appendices.

ONHP, 1995. Rare, Threatened and Endangered plants and animals of Oregon. Oregon Natural Heritage Program, Portland, Oregon. 84 pp.

Pennak, R. W. 1989. *Fresh-water Invertebrates of the United States* [3rd ed.]. Wiley-Interscience, NY. 628 pp.

Pilsbry, H. A. 1939. Land Mollusca of North America (North of Mexico), vol. 1 pt. 1. Academy of Natural Sciences of Philadelphia Monograph 3 (1): 1-574.

----------------. 1940. Land Mollusca of North America (North of Mexico), vol. 1 pt. 2. Academy of Natural Sciences of Philadelphia Monograph 3 (1): 575-994.

----------------. 1946. Land Mollusca of North America (North of Mexico), vol. 2 pt. 1. Academy of Natural Sciences of Philadelphia Monograph 3 (2): 1-520.

----------------. 1948. Land Mollusca of North America (North of Mexico), vol. 2. pt. 2. Academy of Natural Sciences of Philadelphia Monograph 3 (2): 521-1113.

Riedel, A. 1980. *Genera Zonitidarum.* W. Backhuys, Rotterdam. 197 pp.

ROD. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. U.S. Department of Agriculture, Forest Service, Portland, Oregon. ii + 73 pp.; viii + 143 pp.

Roth, B. 1972. Rare and endangered land mollusks in California. Sterkiana 48: 4-16.

----------. 1993. Critical Review of Terrestrial Mollusks Associated with Late-Successional and Old-Growth Forests in the Range of the Northern Spotted Owl. Barry Roth, San Francisco, California. ii + 42 pp.

_______, & P. Pressley. 1983. New range information on two west American slugs (Gastropoda: Pulmonata: Arionidae). Bulletin, Southern California Academy of Sciences 82: 71-78.

Repenning, C. A., T. R. Weasma, & G. R. Scott. 1995. The Early Pleistocene (Latest Blancan-Earliest Irvingtonian) Froman Ferry Fauna and History of the Glenns Ferry Formation, Southwestern Idaho. U. S. Geol. Sur. Bulletin 2105, 86 pp.

ROD. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. U.S. Department of Agriculture, Forest Service, Portland, Oregon. ii + 73 pp.; vii + 143 pp.

Sarna-Wojcicki, A. M. 1976. Correlation of late Cenozoic tuffs in the central Coast Ranges of

California by means of trace- and minor-element chemistry. U.S. Geological Survey Professional Papers, 370: 1-143.

Scoppettone, G. G., & G. Vinyard. 1991. Life History and Management of Four Endangered Lacustrine Suckers, pp. 359-377, In Minkley, W. L. & J. E. Deacon (eds.). 1991. *Battle against Extinction. Native Fish Management in the American West.* University of Arizona Press, 517 pp.

SEIS, 1993. Draft Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. U. S. Department of Agriculture, Forest Service, Portland, Oregon. viii + 269 pp., appendices.

SEIS, 1994. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. U. S. Department of Agriculture, Forest Service, Portland, Oregon. Vol. 1, xvi + 532 pp.; vol. 2, 521 pp.[appendices].

Sigler, W. F. & J. W. Sigler. 1987. *Fishes of the Great Basin.* University of Nevada Press, 425 pp.

Smith, G. R. 1975. Fishes of the Glenns Ferry Formation, southwest Idaho. University of Michigan Museum of Paleontology, Papers on Paleontology 14:1-68.

---------------. 1978. Biogeography of intermountain fishes, pp. 17-42. In K. T. Harper & J. L. Reveal (eds.), Intermountain biogeography: A symposium. Great Basin Naturalist Memoirs 2, 404 pp.

--------------. 1981. Late Cenozoic freshwater fishes of North America. Annual Review of Ecology & Systematics 12: 163-193.

Stimpson, W. 1865a. Diagnoses of Newly Discovered Genera of Gasteropods, Belonging to the Sub-fam. Hydrobiinae, of the Family Rissoidae. American Journal of Conchology, 1: 52-54.

-----------------. 1865b.Researches Upon the Hydrobiinae and Allied Forms; Chiefly Made Upon Materials in the Museum of the Smithsonian Institution. Smithsonian Miscellaneous Collections, 201: 1-59.

Taylor, D. 1966a. Summary of North American Blancan nonmarine mollusks. Malacologia 4: 1-172.

------------. 1966b. A remarkable snail fauna from Coahuila, Mexico. Veliger 9: 152-228.

------------. 1975. Index and Bibliography of Late Cenozoic Freshwater Mollusca of Western North America. University of Michigan Museum of Paleontology, Papers on Paleontology 10, 384 pp.

-----------. 1977. Rocky Mountain and Intermountain Freshwater Molluscs: an Annotated List unpub. ms., 40 pp.

---------. 1981. Freshwater mollusks of California: a Distributional checklist. California Fish & Game 67: 140-163.

---------. 1985. Evolution of freshwater drainages and molluscs in western North America. *In* Smiley, C. J. (ed.) *Late Cenozoic History of the Pacific Northwest.* San Francisco, AAAS, Pacific Division, pp. 265-321.

---------. 1987. *Fresh-water molluscs from New Mexico and vicinity.* New Mexico Bureau of Mines & Mineral Resources, Bulletin 116, 50 pp.

---------. 1988a. New species of *Physa* (Gastropoda: Hygrophila) from the western United States. Malacological Review 21: 43-79.

---------. 1988b. Aspects of Freshwater Mollusc Ecological Biogeography. Palaeogeography, Palaeoclimatology, Palaeoecology 62: 511-576.

--------, & R. Bright. 1987. Drainage History of the Bonneville Basin, pp. 239-256, *in* R. S. Kopp & R. E. Cohenour (*eds.*), *Cenozoic Geology of western Utah. Sites for Precious Metal and Hydrocarbon Accumulations.* Utah Geological Association, Publications, 16, 684 pp.

--------, & A. G. Smith. 1971. Harold Hannibal (1889-1965) with a review of his molluscan research. The Veliger 13: 303-315.

--------, & G. R. Smith. 1981. Pliocene molluscs and fishes from northeastern California and northwestern Nevada. University of Michigan Museum of Paleontology, Paleontological Contributions 25: 339-413.

Thompson, F. G. 1984. North American freshwater snail genera of the hydrobiid subfamily Lithoglyphinae. Malacologia 25: 109-141.

Thorp, J. & A. Covich (*eds.*). 1991. *Ecology and Classification of North American Freshwater Invertebrates.* Academic Press. 911 pp.

Turgeon, D. D. *et al.*, 1988. *Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks.* American Fisheries Soc., Spec. Pub. 16, vii + 277 pp.

USFWS. 1992a. Recovery Plan for the Northern Spotted Owl-DRAFT. USFWS, 662 pp.

------------. 1992b. Endangered and Threatened Wildlife and Plants: Determination of Endangered or Threatened Status for Five Aquatic Snails in South Central Idaho. Federal Register 57: 59244-59257.

-----------. 1993. Endangered and Threatened Wildlife and Plants. U. S. Fish and Wildlife Service, 38 p.

-----------. 1994. Endangered and Threatened Wildlife and Plants: Animal Candidate Review for Listing as Endangered or Threatened Species; Proposed Rule. Federal Register 56: 58982-59029.

Vaught, K. 1989. *A Classification of the living Mollusca.* American Malacologists, Inc. 189 pp.

Wheeler, H. E. & E. F. Cook. 1954. Structural and stratigraphic significance of the Snake River capture, Idaho-Oregon. Journal of Geology 62: 525-536.

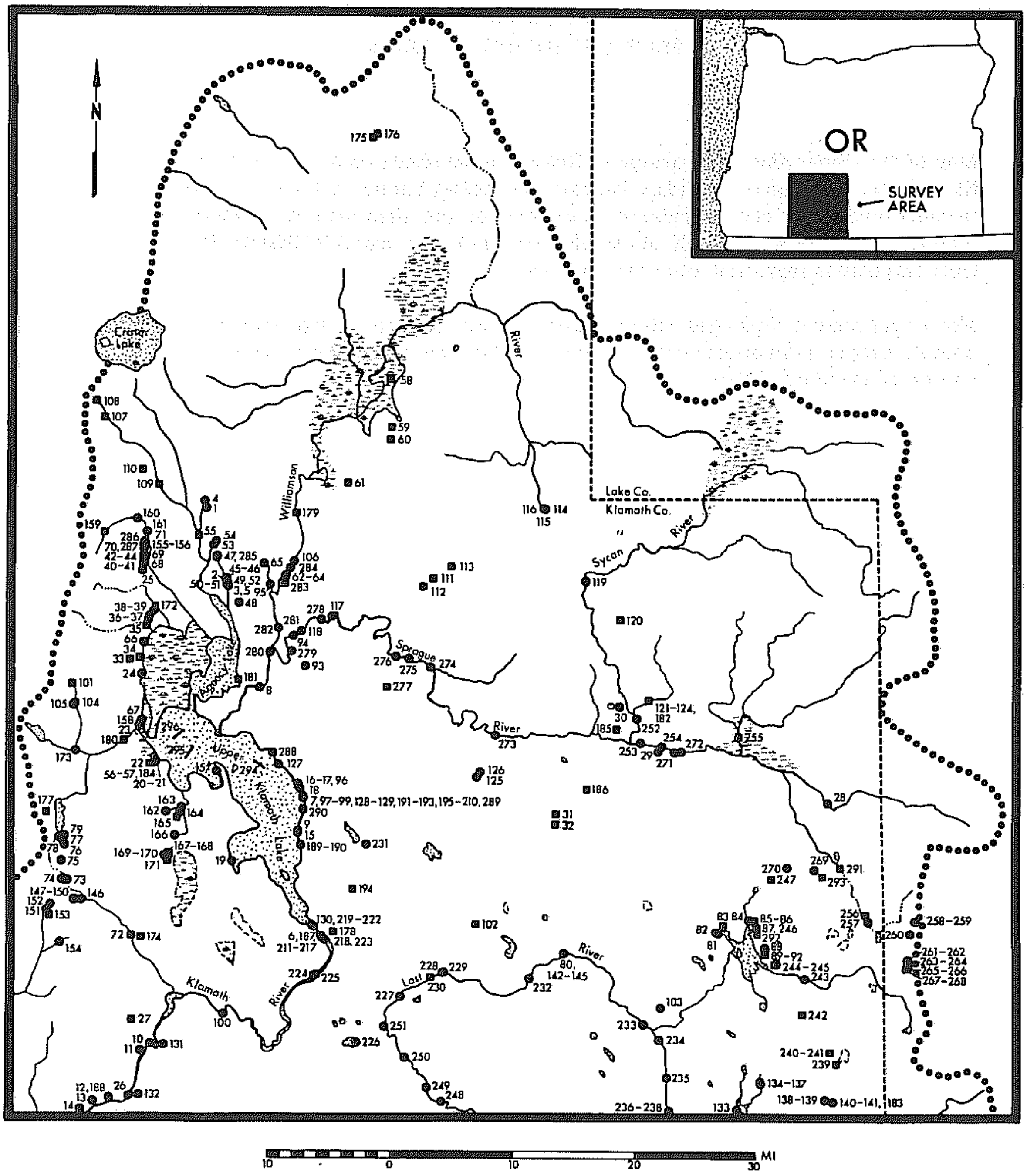
Wu, Shi-Kuei, & N. E. Brandauer. 1982. Type specimens of Recent Mollusca in the University of Colorado Museum. University of Colorado Museum, Natural History Inventory of Colorado no. 7: 47 pp.

FIGURES

FIGURE 1.
MAP OF SURVEY AREA.

Map of the Upper Klamath drainage in Oregon. Inset shows location of survey area. Upper Klamath drainage basin boundary indicated by dotted border. Sites with mollusks shown as numbered black dots; numbered black squares are sites with no mollusk fauna. Site numbers refer to **APPENDIX A** (locality descriptions) and **APPENDIX B** (site maps). Dots sometimes represent more than one site.

Major permanent drainages labeled. Left border of map is the Jackson-Klamath Co. border. Larger permanent water bodies indicated by dot shading; larger marshes also shown by standard pattern.


N
OR
SURVEY AREA
Crater Lake
Williamson
River
Sprague River
Sycan River
Lake Co.
Klamath Co.
Upper Klamath Lake
Klamath River
Lost River
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56-57, 184
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16-17, 96
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130, 219-222
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218, 223
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87, 246
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80, 142-145
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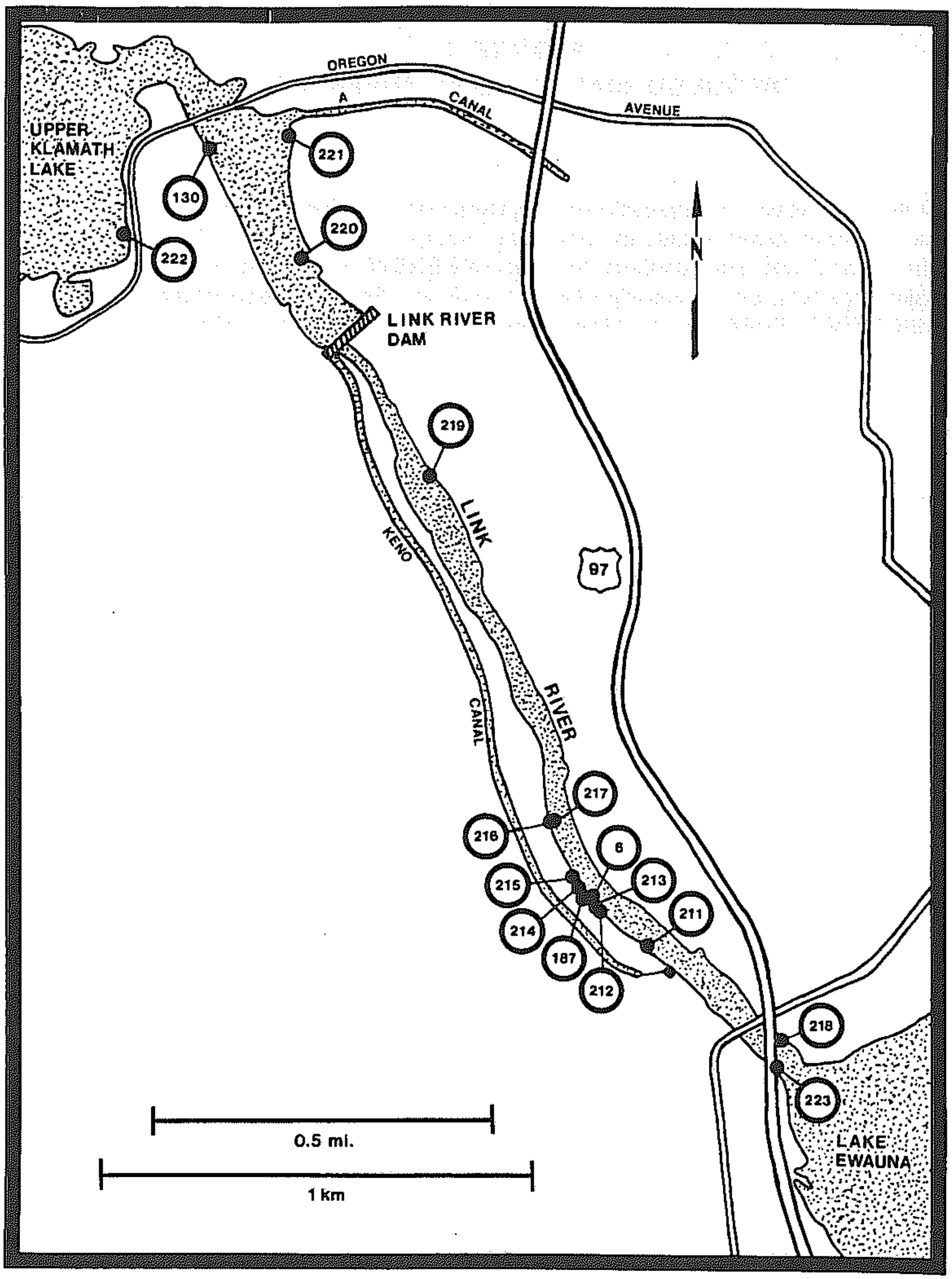
F2

FIGURE 2.
DETAILED MAP OF LINK RIVER AREA.

Map of the Link River and immediately adjacent parts of Upper Klamath Lake and Lake Ewauna. Watered areas shown by irregular stipple. Sites with mollusks shown as numbered black dots. Site numbers refer to **APPENDIX A** (locality descriptions); for discussion, see text. Dots generally represent one site. For discussion of individual taxa, see **SENSITIVE SPECIES**; for distribution, see following maps (**Figures 3-10**)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AVENUE
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CANAL
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LAKE
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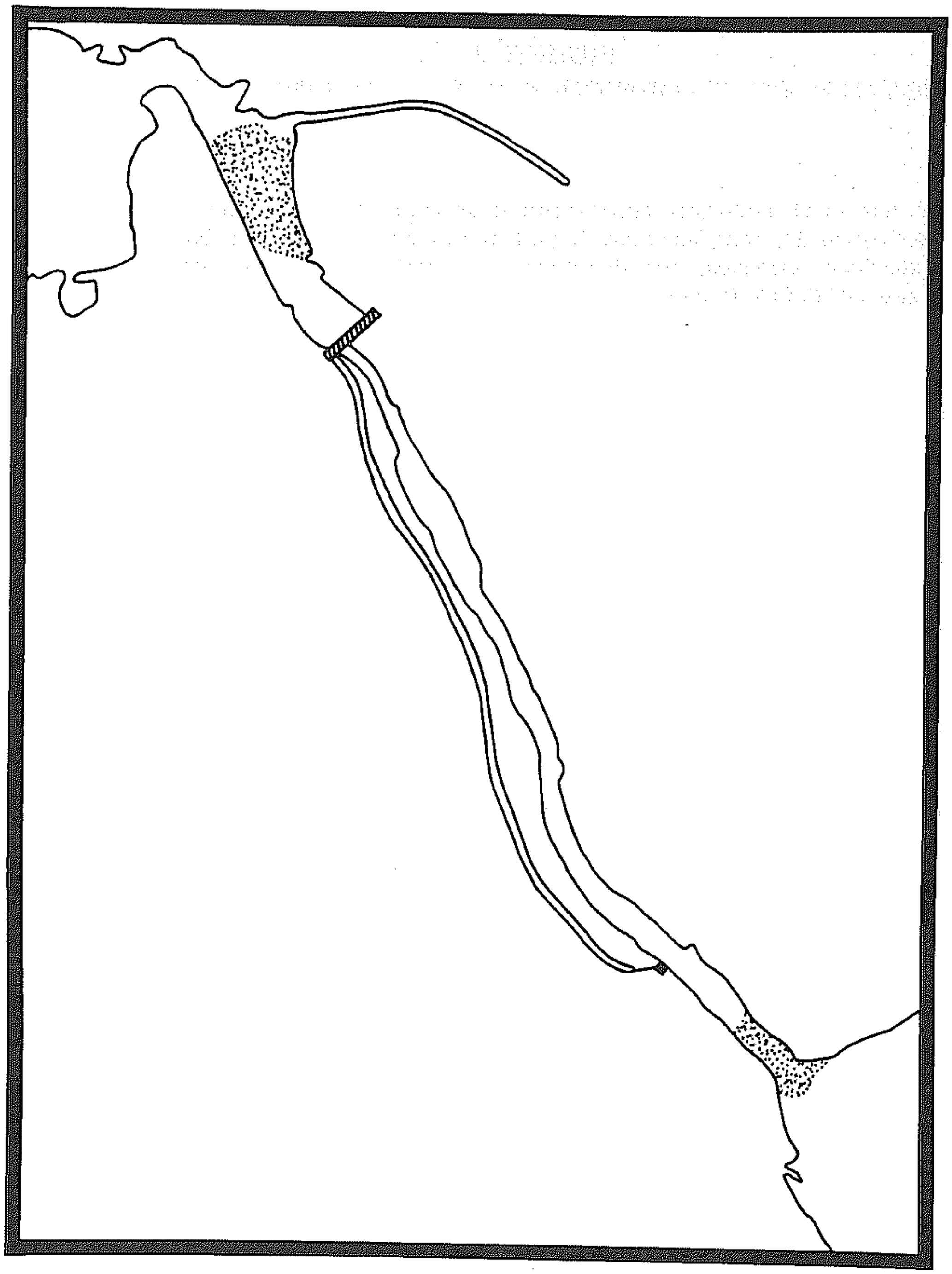
LINK
KENO
97
CANAL
RIVER
217
216
6
215
213
211
214
187
212
218
223
0.5 mi.
1 km
LAKE
EWAUNA

F4

FIGURE 3.
DISTRIBUTION OF *FLUMINICOLA* N. SP. 1 IN LINK RIVER AREA.

Areas with this small freshwater snail shown as irregular stipple in normally watered areas (see **Figure 2**). Note limitation to part of area above Link River Dam and small area at Link River terminus. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D2.

Fluminicola n. sp. 1

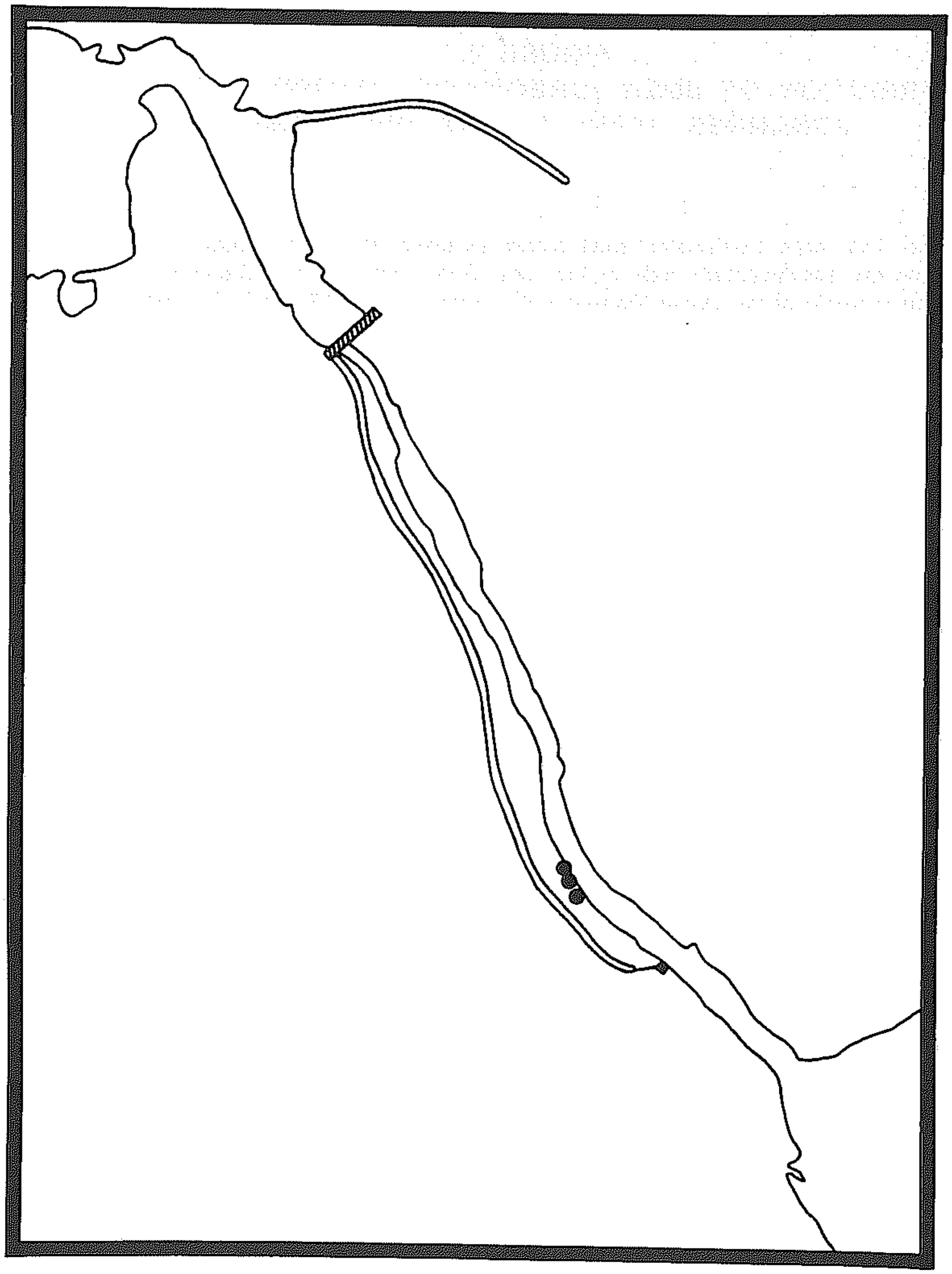


F6

FIGURE 4.
DISTRIBUTION OF *JUGA (OREOBASIS) "NIGRINA"* FREST & JOHANNES, 1995B, IN LINK RIVER AREA.

Areas with this large freshwater snail shown as black dots. Note limitation to a few springs on the southwestern side of the Link River above Keno Canal outfall. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D7.

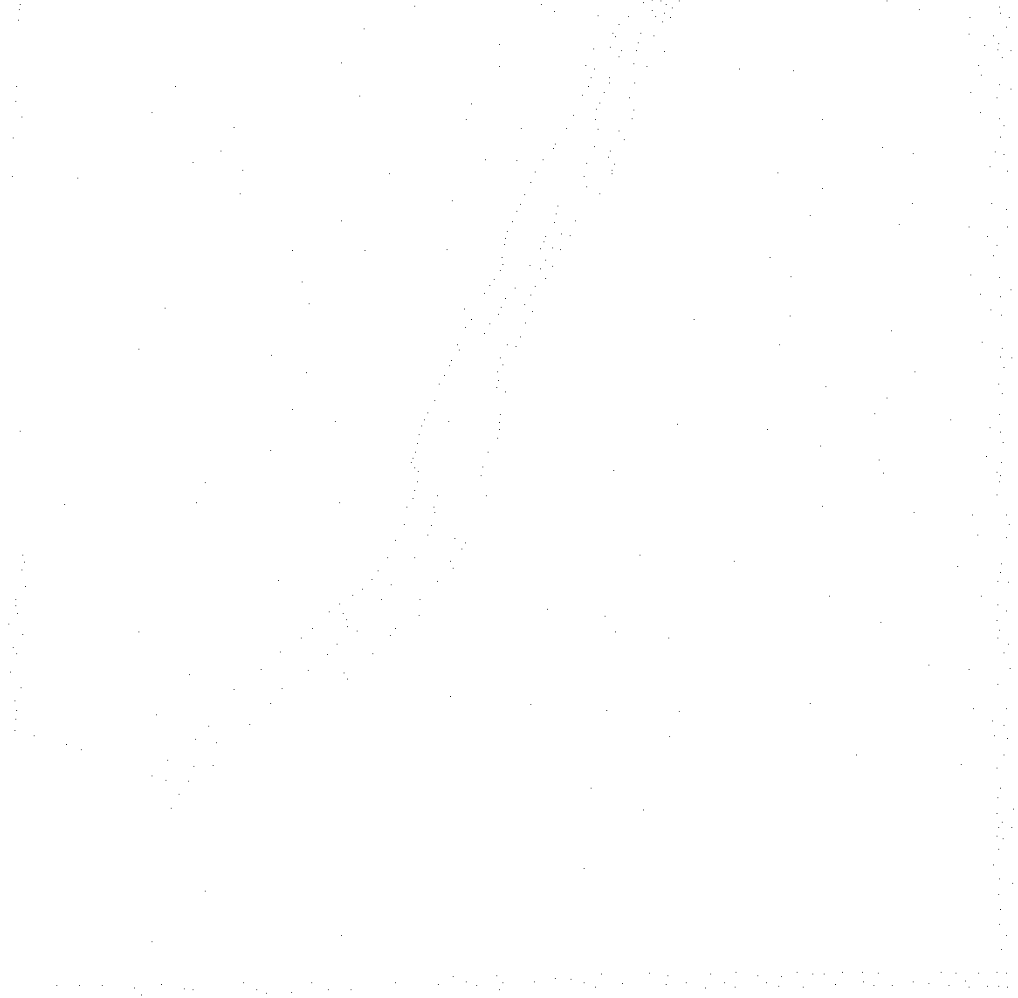
Juga (Oreobasis) "nigrina" Frest & Johannes, 1995b



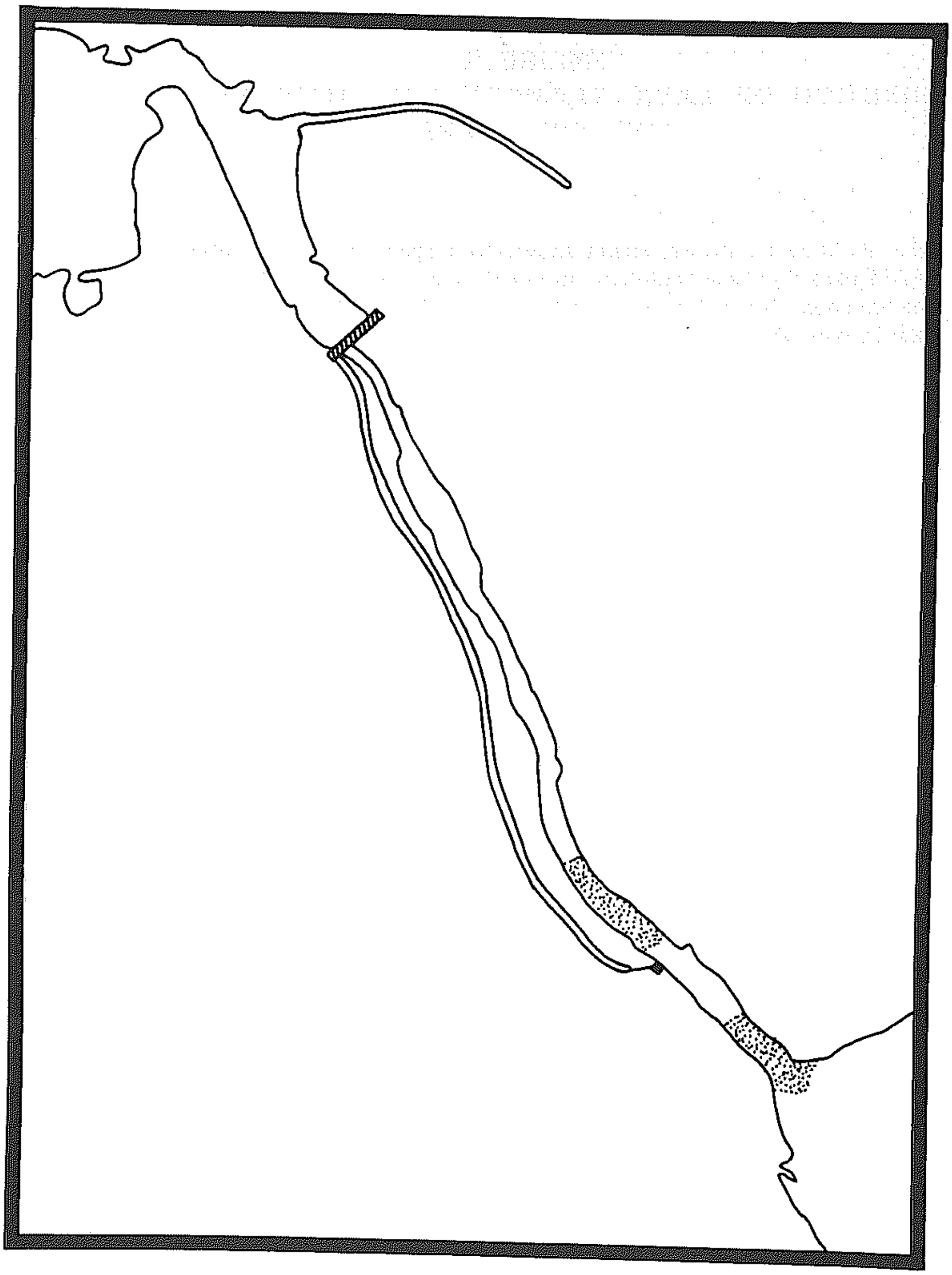
F8

FIGURE 5.
DISTRIBUTION OF *LANX KLAMATHENSIS* HANNIBAL, 1912 IN LINK RIVER AREA.

Areas with this large freshwater limpet shown as irregular stipple in normally watered areas (see **Figure 2**). Note limitation to small areas above Keno Canal outfall and at Link River terminus. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D8.



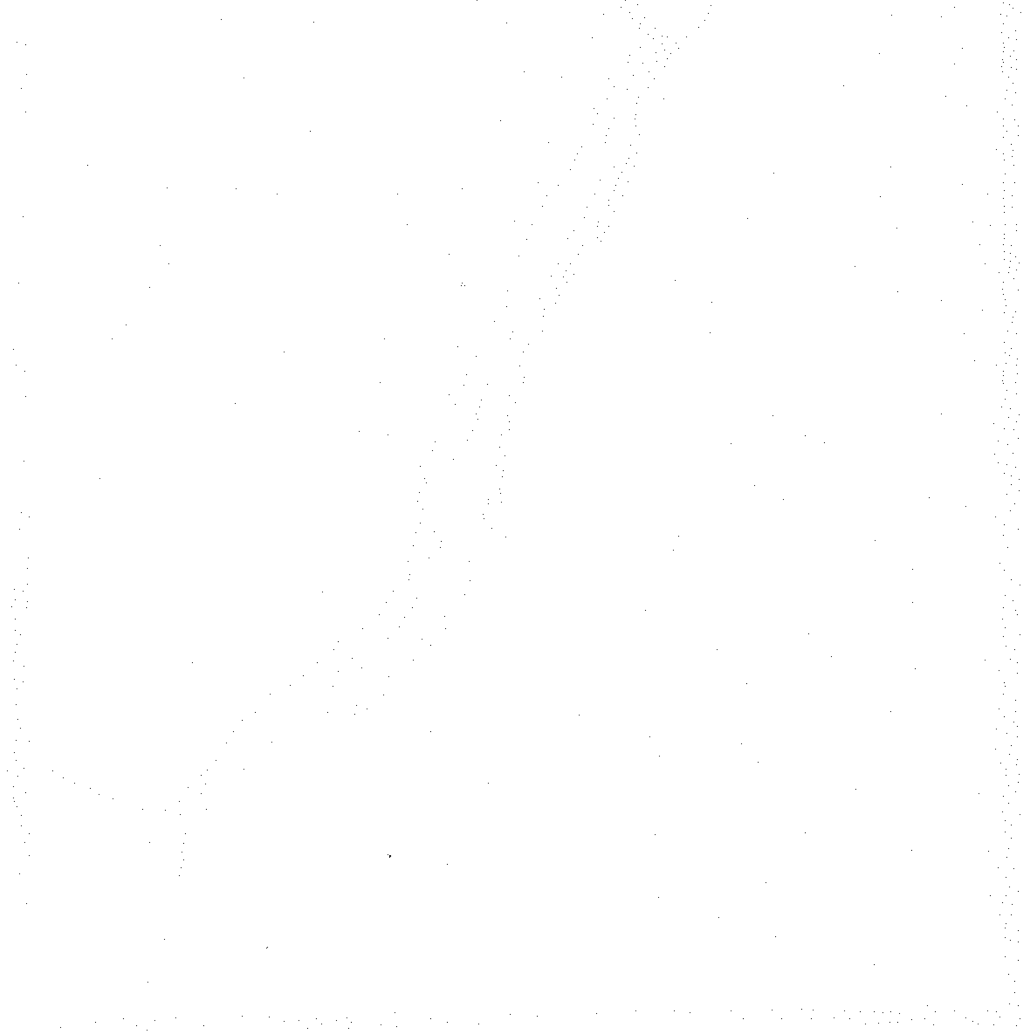
Lanx klamathensis Hannibal, 1912



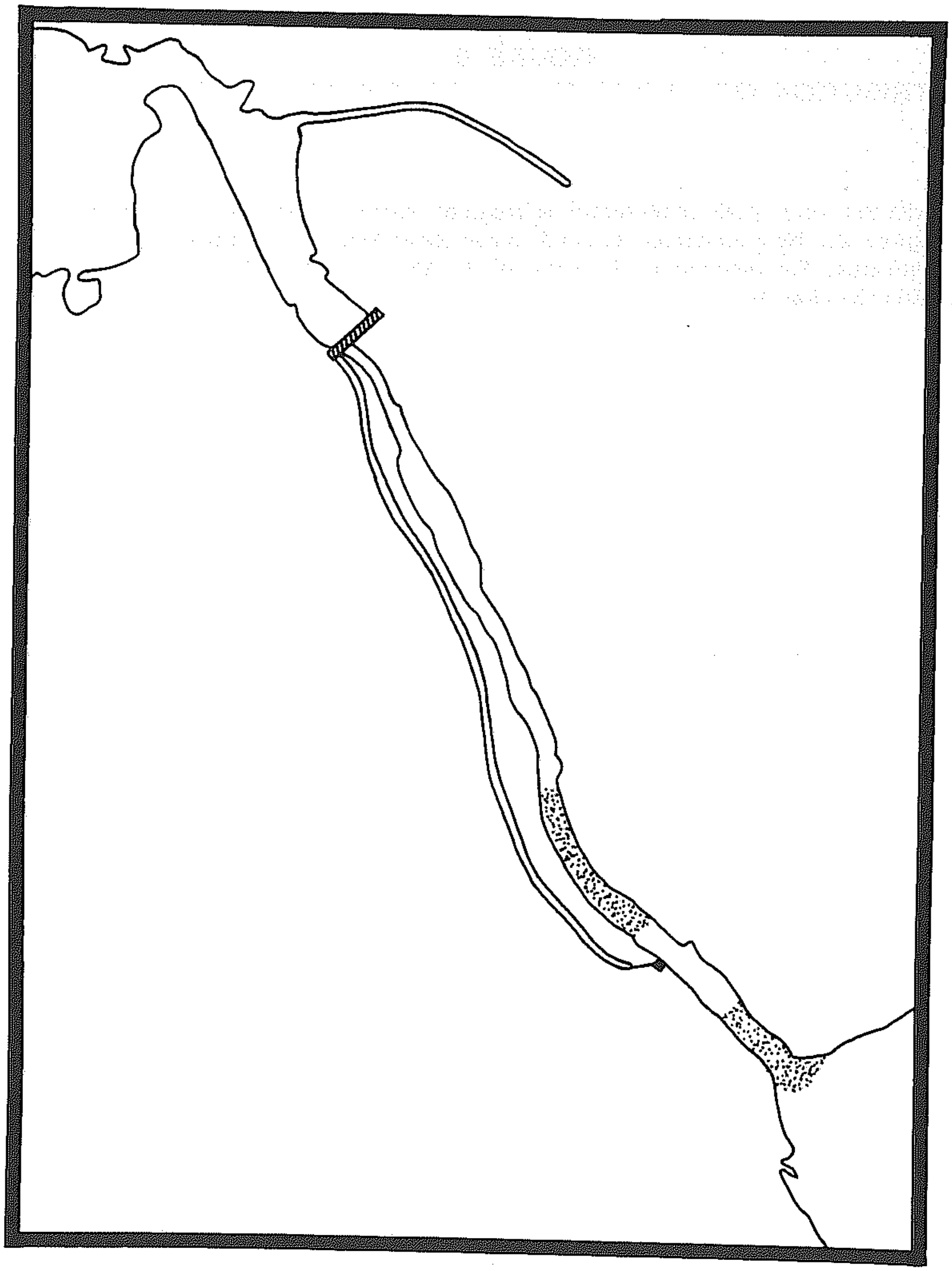
F10

FIGURE 6.
DISTRIBUTION OF *LYOGYRUS* N. SP. 3 IN LINK RIVER AREA.

Areas with this very small snail shown as irregular stipple in normally watered areas (see **Figure 2**). Note limitation to small areas above Keno Canal outfall and at Link River terminus. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D9.



Lyogyrus n. sp. 3

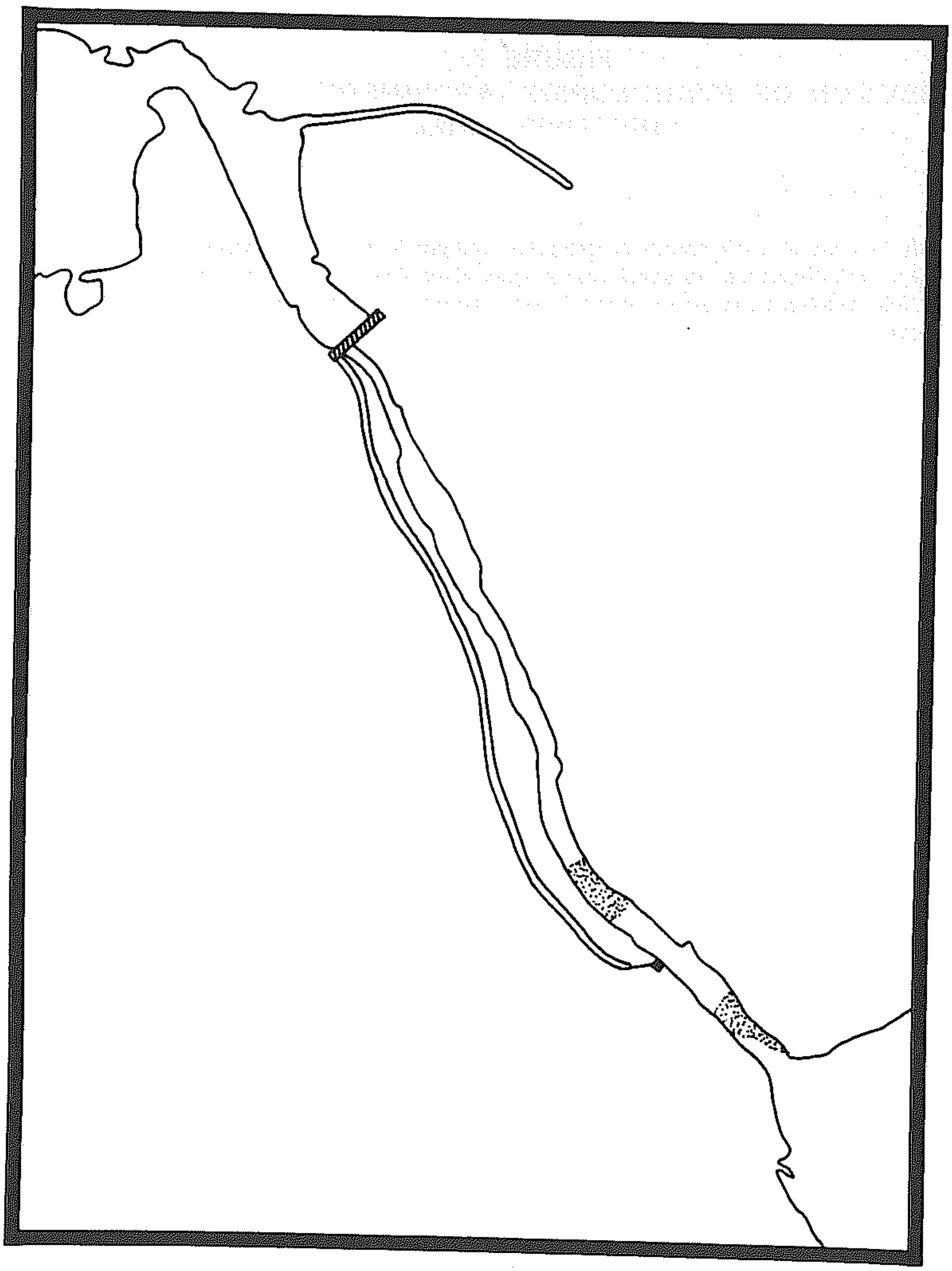


F12

FIGURE 7.
DISTRIBUTION OF *PYRGULOPSIS ARCHIMEDIS* BERRY, 1947 IN LINK RIVER AREA.

Areas with this small snail shown as irregular stipple in normally watered areas (see **Figure 2**). Note limitation to small areas above Keno Canal outfall and at Link River terminus. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D10.

Pyrgulopsis archimedis Berry, 1947

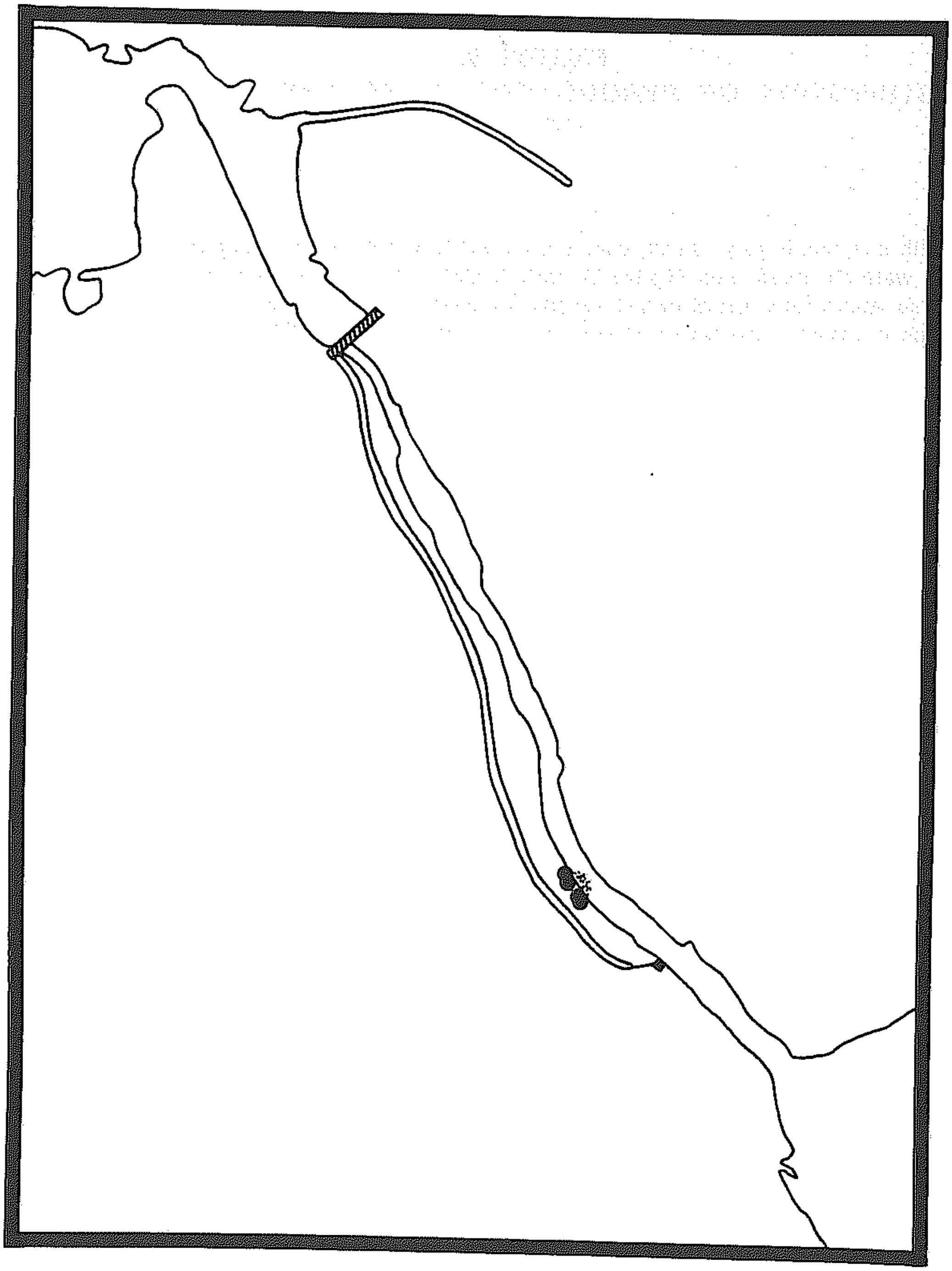


F14

FIGURE 8.
DISTRIBUTION OF *PYRGULOPSIS* N. SP. 1 IN LINK RIVER AREA.

Areas with this small-very small snail shown as black dots and as irregular stipple in normally watered areas (see **Figure 2**). Note limitation to a few springs and very small river area above Keno Canal outfall on the southwestern side of the Link River. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D10.

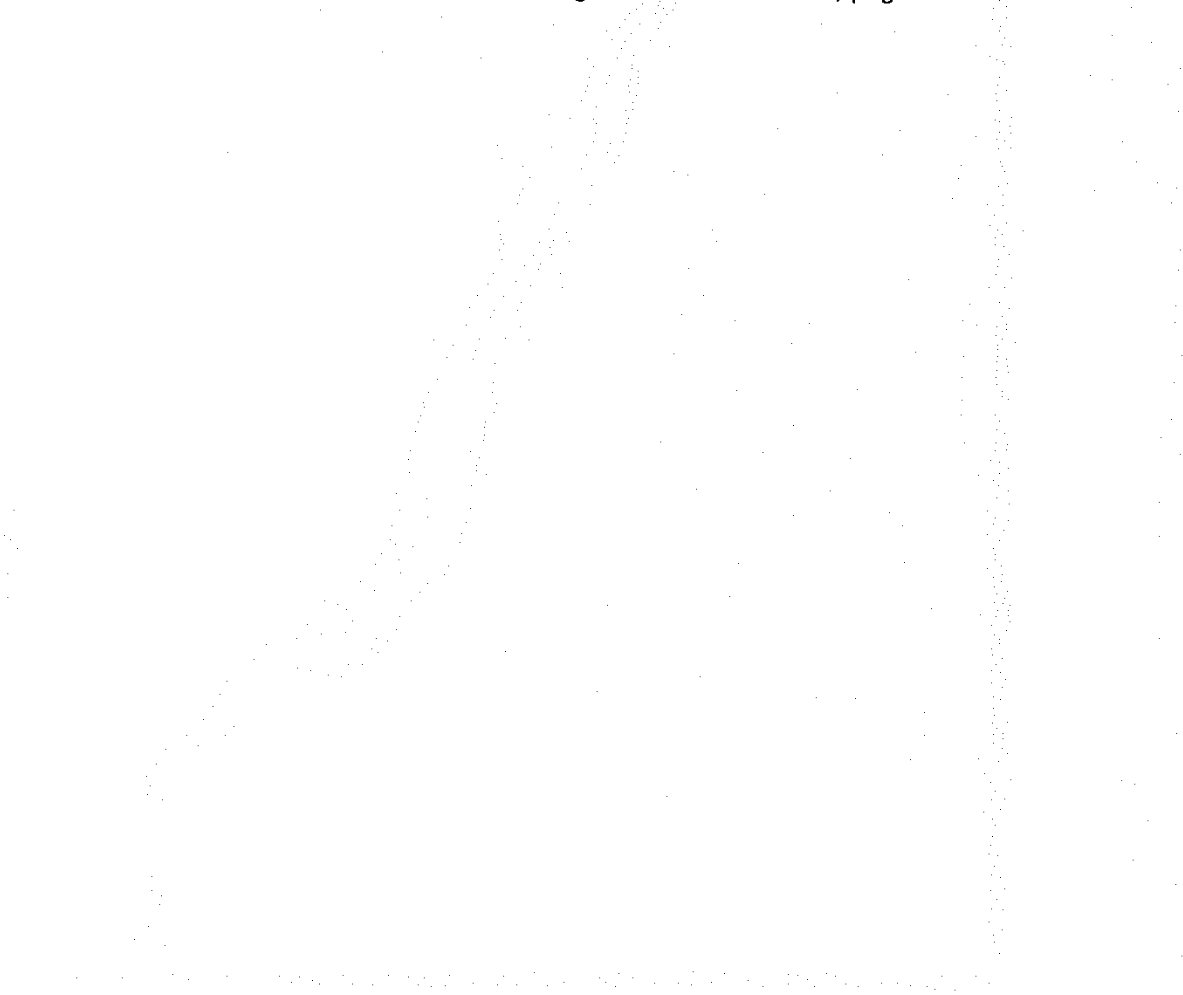
Pyrgulopsis n. sp. 1



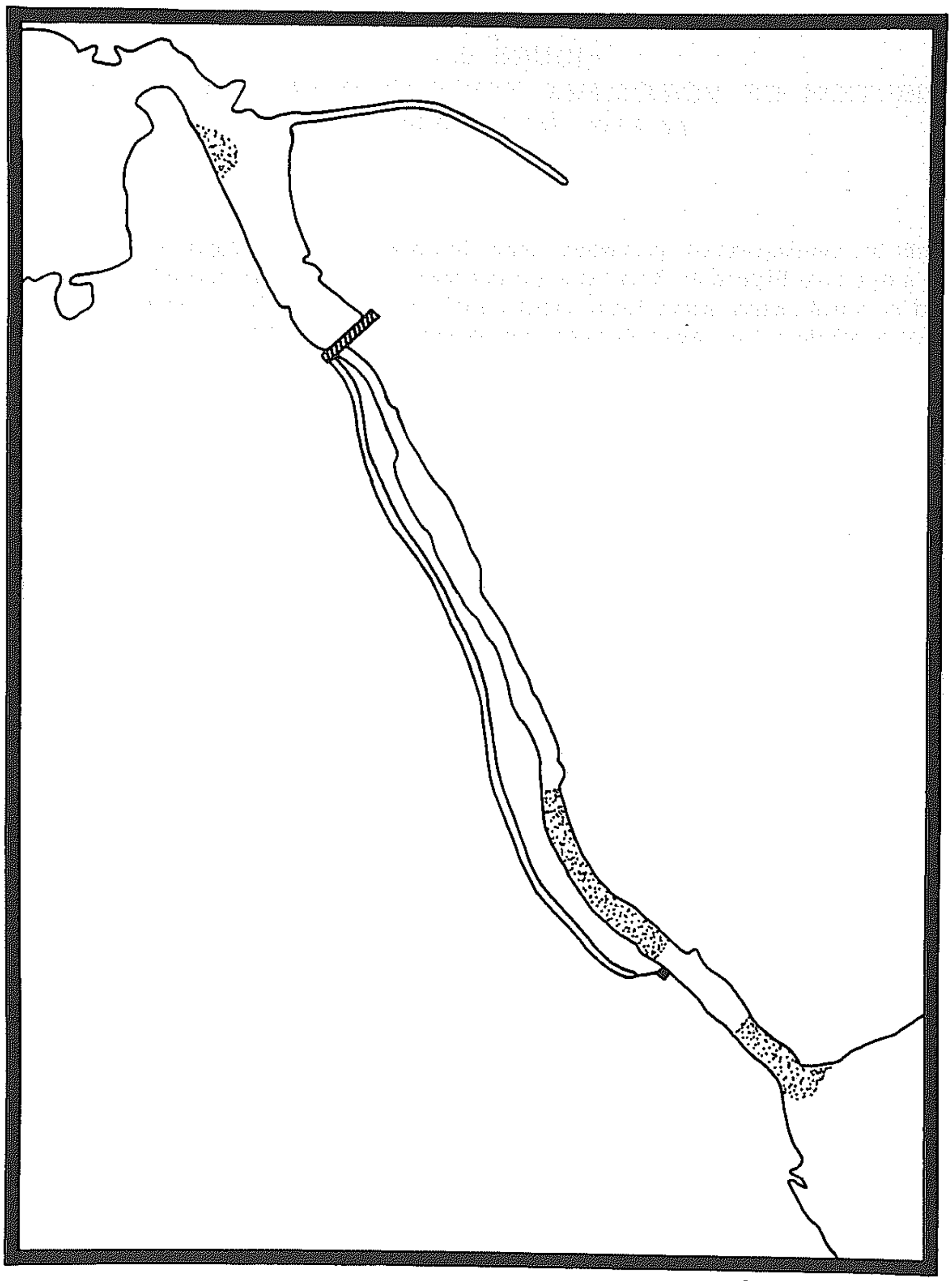
F16

FIGURE 9.
DISTRIBUTION OF *VORTICIFEX EFFUSUS DALLI* (BAKER, 1945) IN LINK RIVER AREA.

Areas with this medium-sized freshwater snail shown as irregular stipple in normally watered areas (see **Figure 2**). This taxon occurs only in a small area above Link River Dam and in small areas above Keno Canal outfall and at Link River terminus. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D11.



Vorticifex effusus dalli (Baker, 1945)

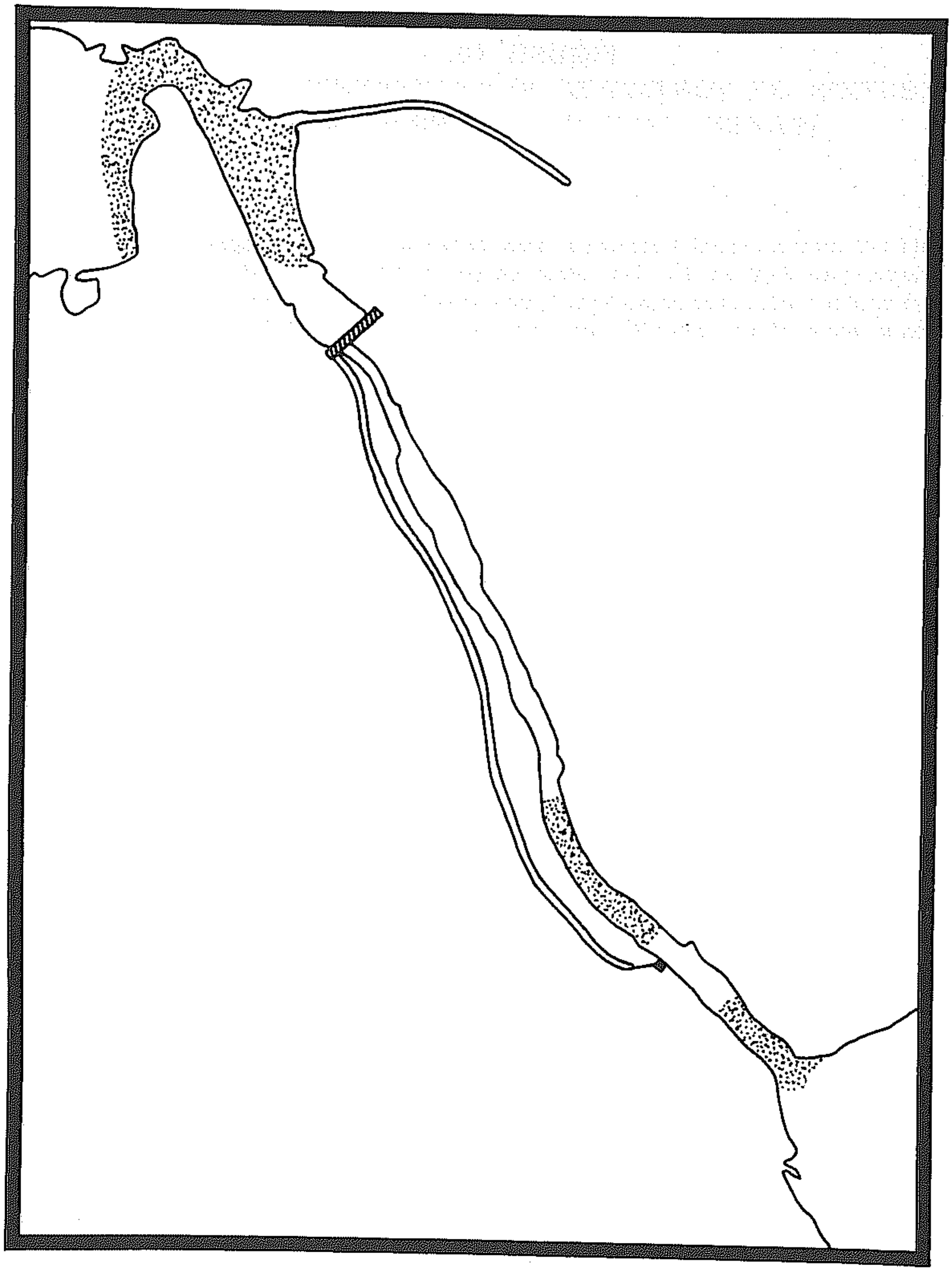


F18

FIGURE 10.
DISTRIBUTION OF *VORTICIFEX KLAMATHENSIS KLAMATHENSIS* (BAKER, 1945) IN LINK RIVER AREA.

Areas with this medium-sized freshwater snail shown as irregular stipple in normally watered areas (see **Figure 2**). This taxon occurs in a fairly broad area above Link River Dam and in small areas above Keno Canal outfall and at Link River terminus. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D13.

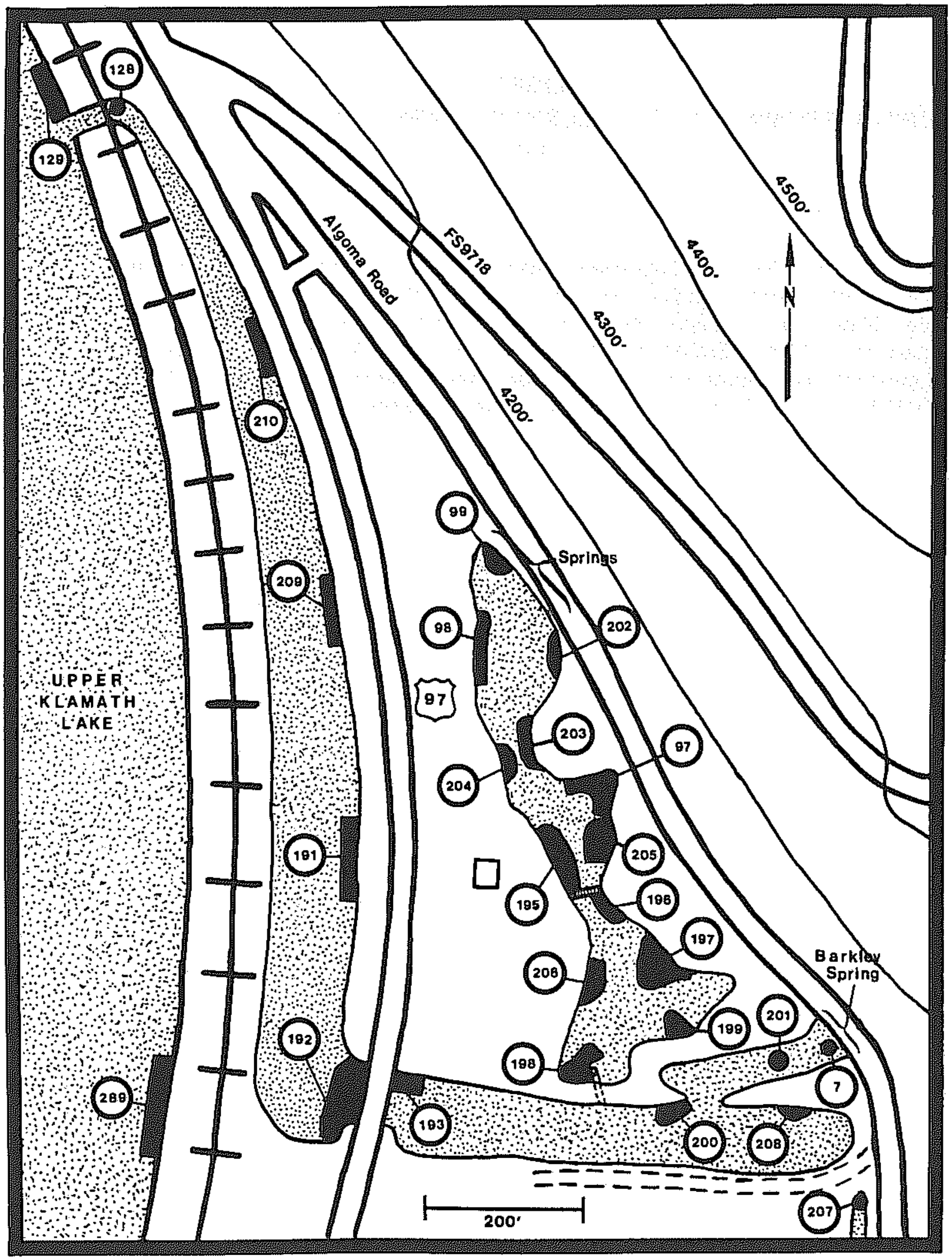
***Vorticifex klamathensis klamathensis* (Baker, 1945)**



F20

FIGURE 11.
DETAILED MAP OF HAGELSTEIN PARK (BARKLEY SPRINGS) AREA.

Map of Hagelstein Park and immediately adjacent parts of Upper Klamath Lake, including Barclay Spring, south channel, and west channel. Watered areas shown by irregular stipple. Sites with mollusks shown as numbered black areas of varying size. Site numbers refer to **APPENDIX A** (locality descriptions); for discussion, see text. Each area generally represents one site. For discussion of individual taxa, see **SENSITIVE SPECIES**; for distribution, see following maps (**Figures 12-23**).

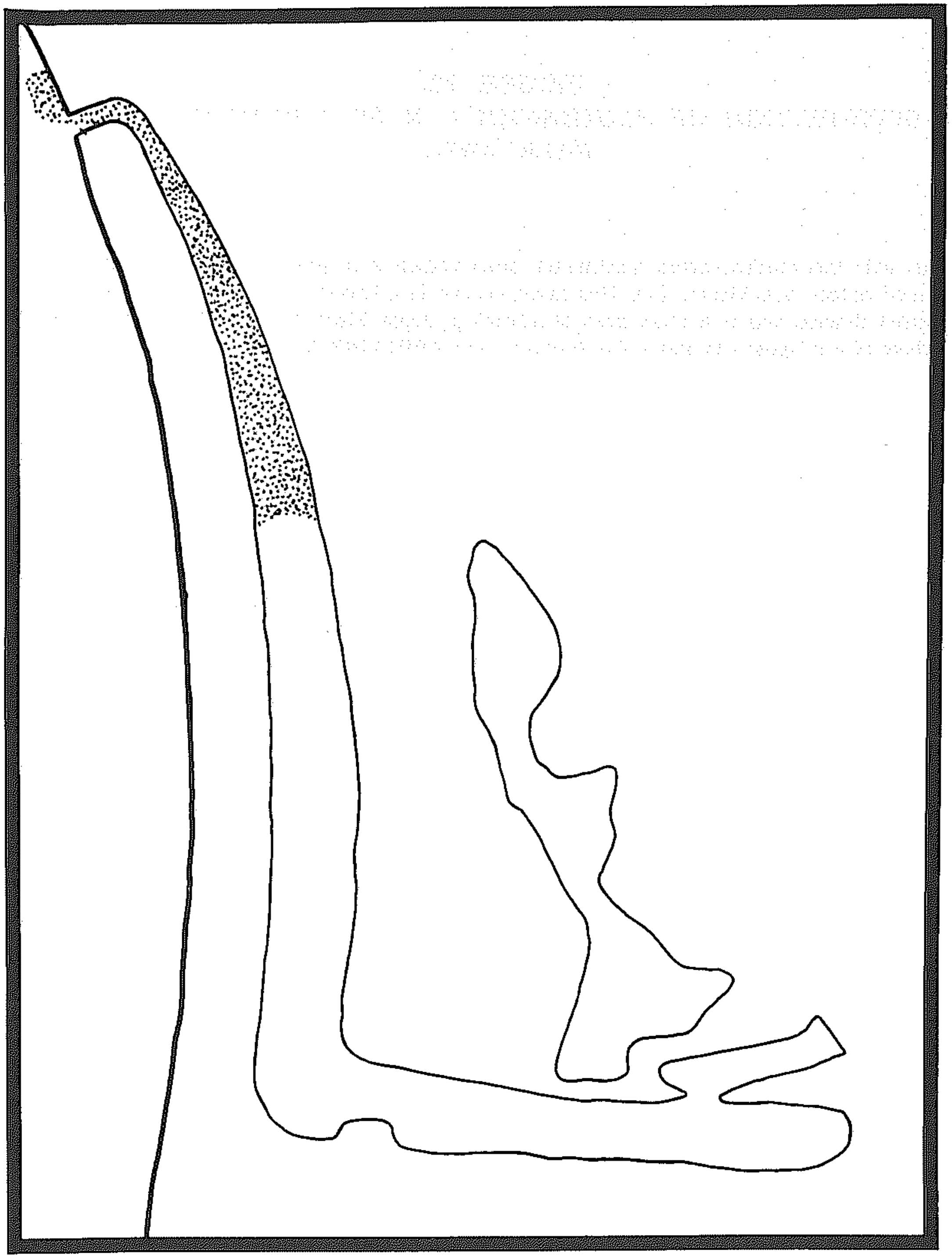

128
129
210
209
UPPER
KLAMATH
LAKE
191
192
289
193
Algoma Road
FS9718
4200'
4300'
4400'
4500'
N
99
Springs
98
202
97
203
97
204
205
195
196
197
206
199
201
Barkley
Spring
198
7
200
208
207
200'

F22

FIGURE 12.
DISTRIBUTION OF *FLUMINICOLA* N. SP. 1 IN HAGELSTEIN PARK AREA.

Areas with this medium-sized freshwater snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in a limited area in the north part of the west channel and in a small area of adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D2.

Fluminicola n. sp. 1

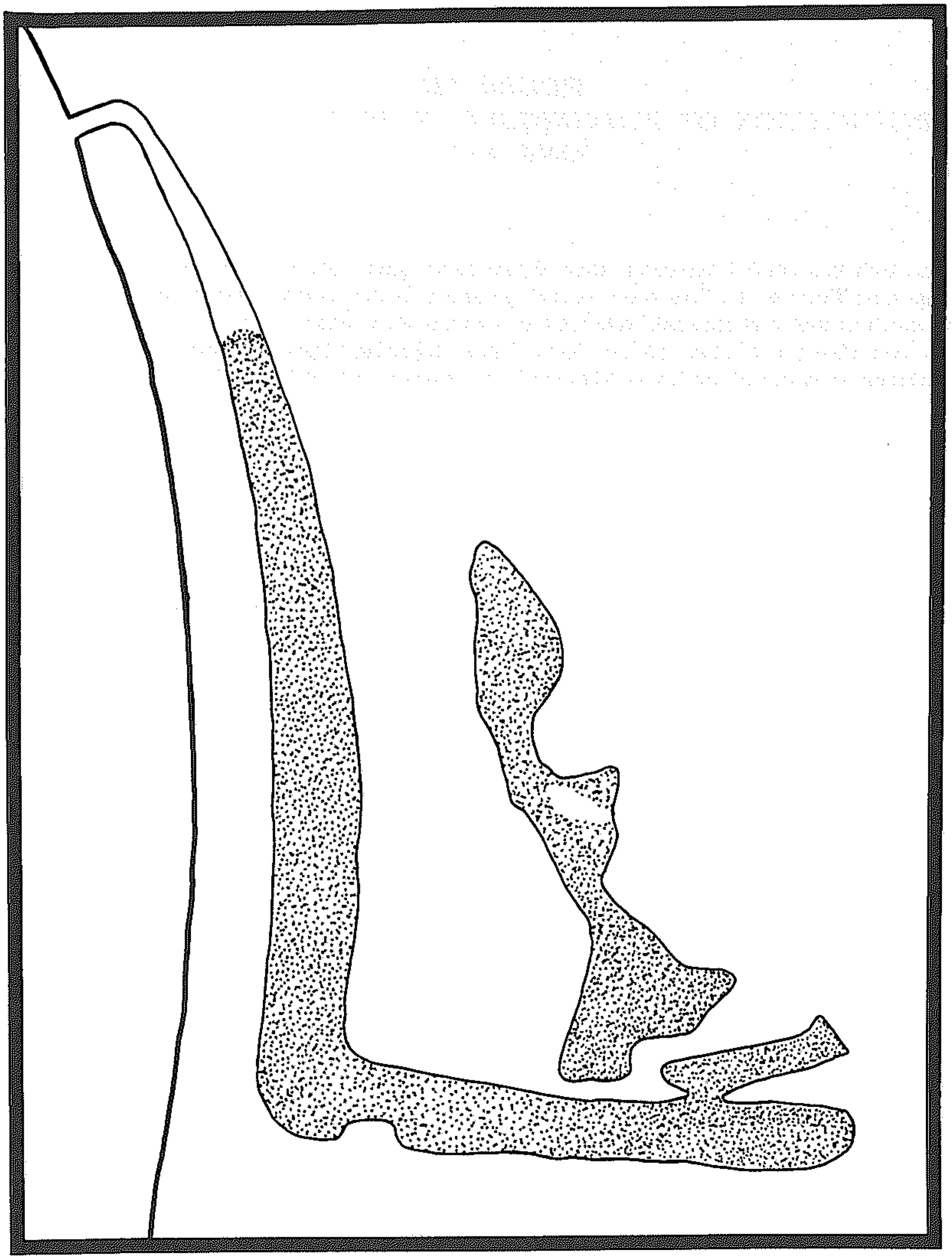


F24

FIGURE 13.
DISTRIBUTION OF *FLUMINICOLA* N. SP. 27 IN HAGELSTEIN PARK AREA.

Areas with this small freshwater snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs generally in the springs area, south channel, and much of the west channel. Note limited overlap with *Fluminicola* n. sp. 1 (Figure 12) and absence of this spring form from adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D2.

Fluminicola n. sp. 27

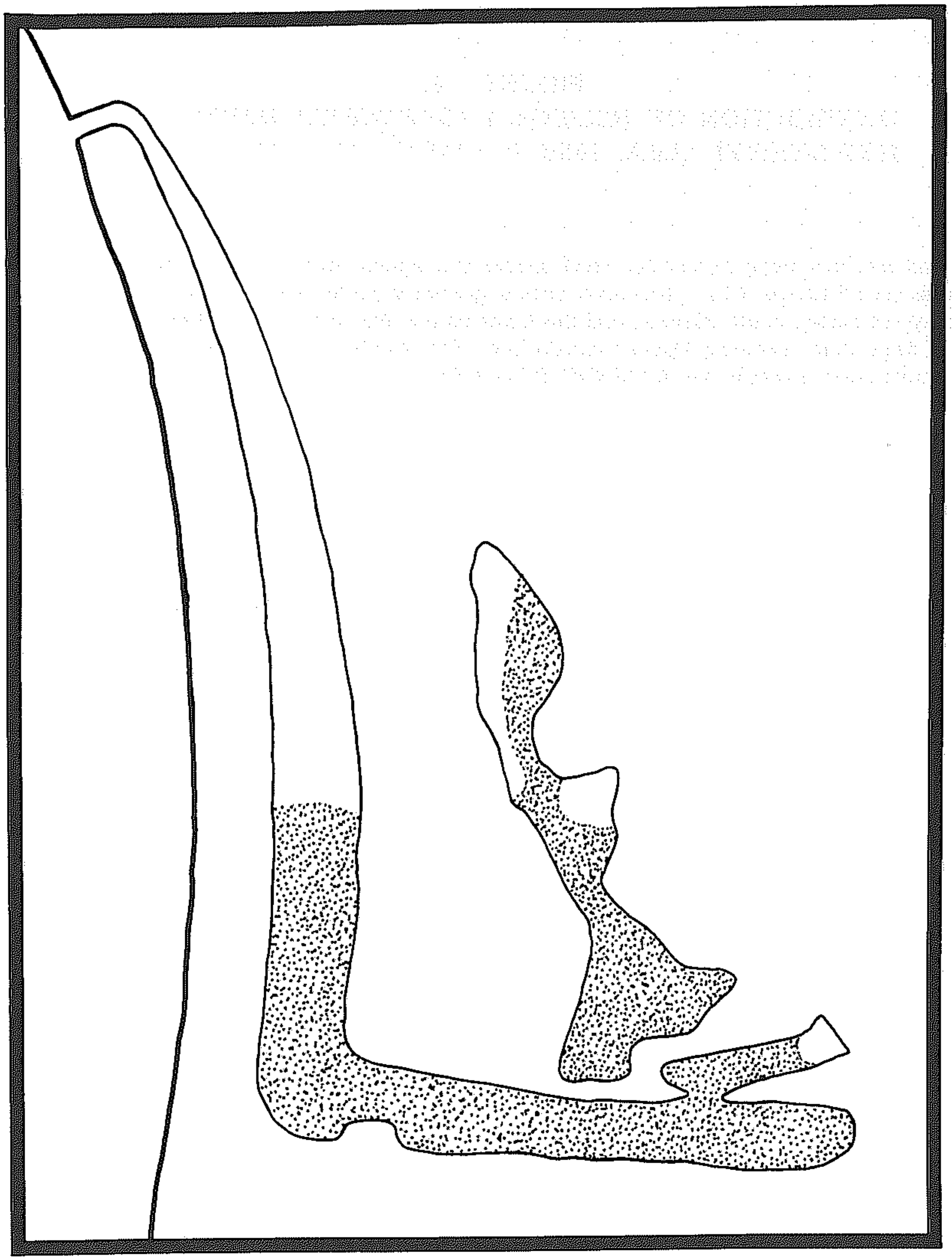


F26

FIGURE 14.
DISTRIBUTION OF *HELISOMA (CARINIFEX) NEWBERRYI NEWBERRYI* (LEA, 1858) IN HAGELSTEIN PARK AREA.

Areas with this large freshwater snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs generally in the springs area (except on rocky substrate), south channel, and the lower part of the west channel. Note absence of this form from adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D6.

Helisoma (Carinifex) newberryi newberryi (Lea, 1858)

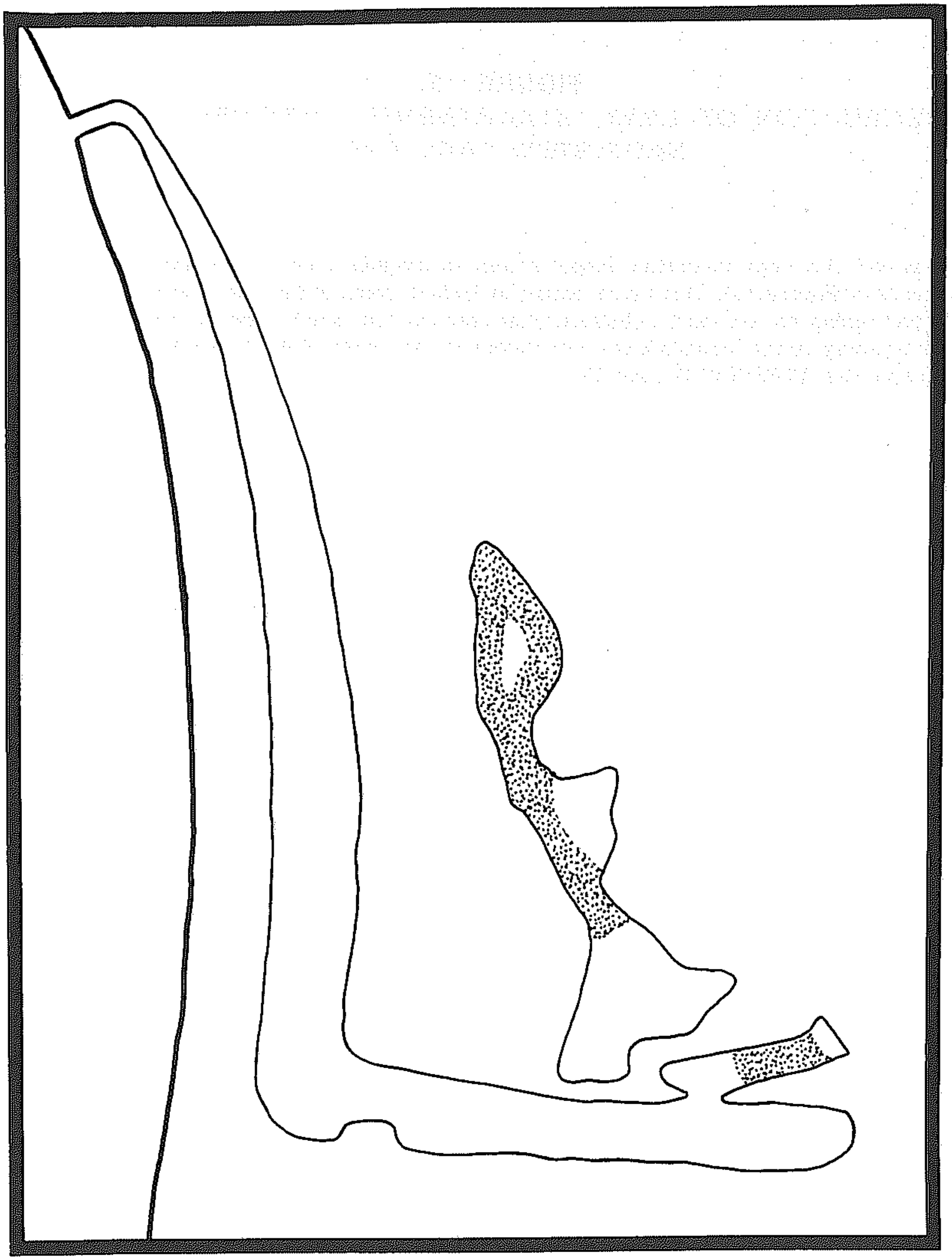


F28

FIGURE 15.
DISTRIBUTION OF *LANX KLAMATHENSIS* HANNIBAL, 1912 IN HAGELSTEIN PARK AREA.

Areas with this large freshwater limpet shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in limited areas of the north spring run and Barclay Spring run on rocky substrate. Note absence from south channel, west channel, and adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D8.

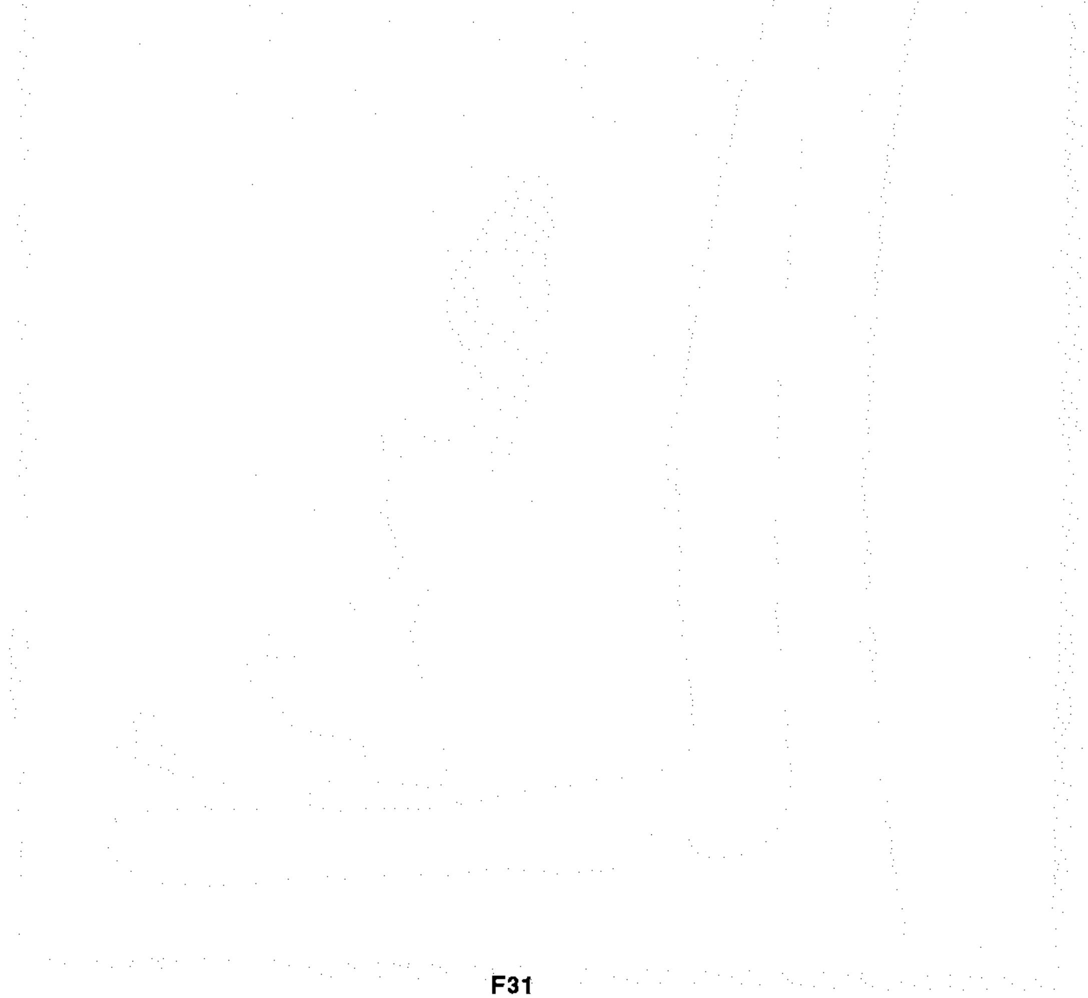
Lanx klamathensis Hannibal, 1912



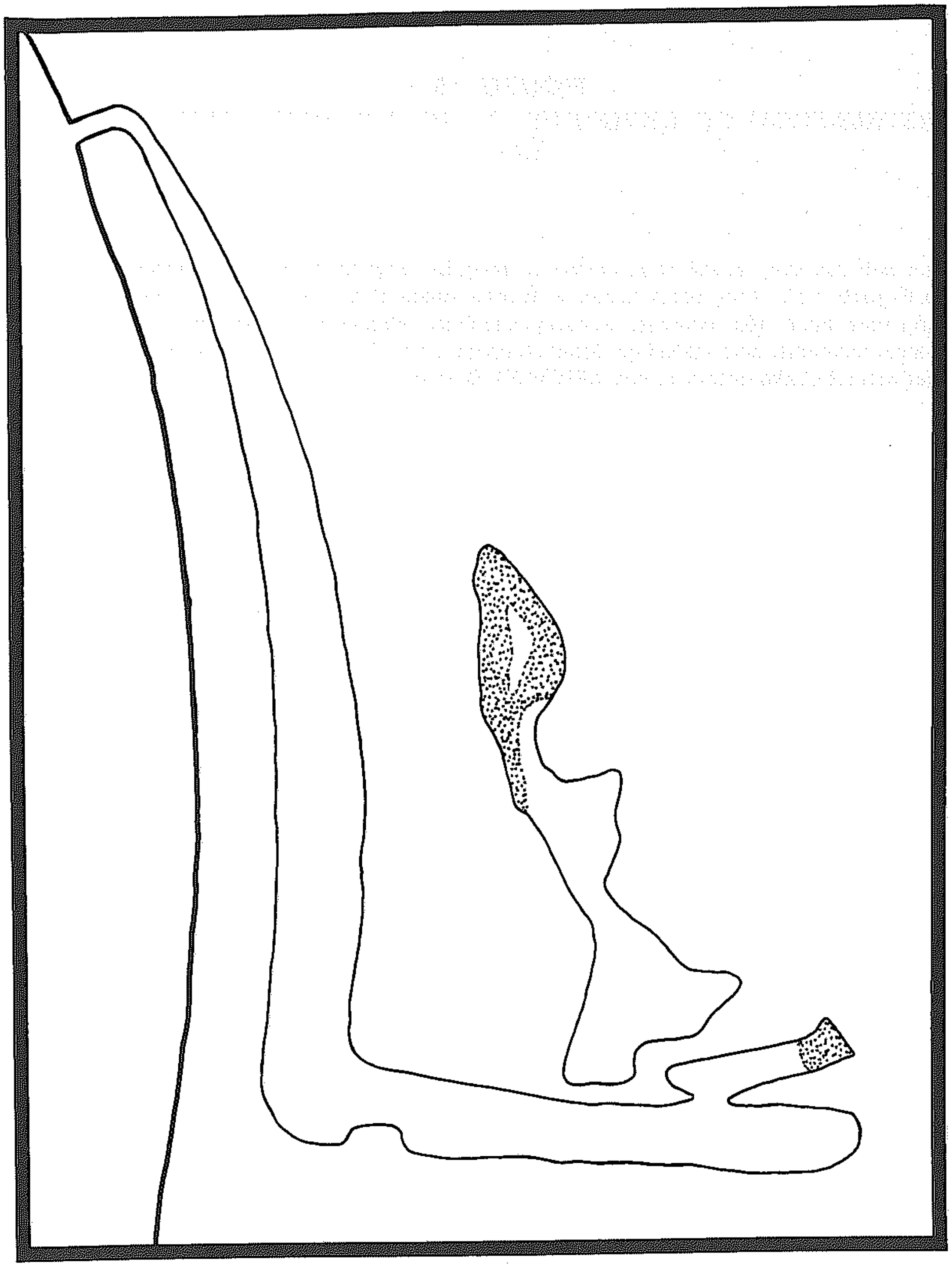
F30

FIGURE 16.
DISTRIBUTION OF *LYOGYRUS* N. SP. 4 IN HAGELSTEIN PARK AREA.

Areas with this very small snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in limited areas of the north spring and Barclay Spring runs near their sources, on rocky substrate. Note absence from much of spring run area, channels, and adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D9.



Lyogyrus n. sp. 4

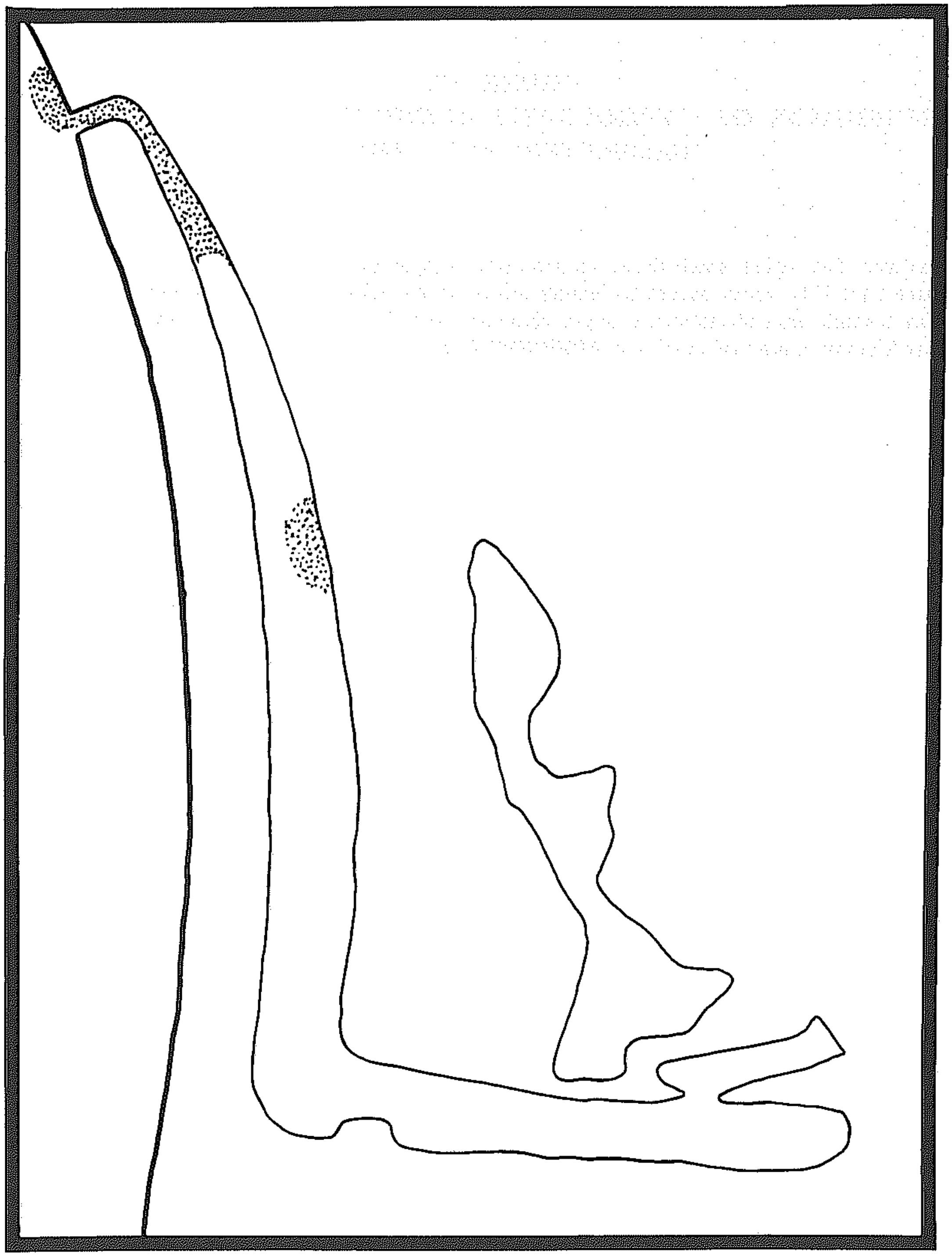


F32

FIGURE 17.
DISTRIBUTION OF *PYRGULOPSIS ARCHIMEDIS* BERRY, 1947 IN HAGELSTEIN PARK AREA.

Areas with this small snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in limited areas of the north portion of the west channel and in a small area of adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D10.

***Pyrgulopsis archimedis* Berry, 1947**

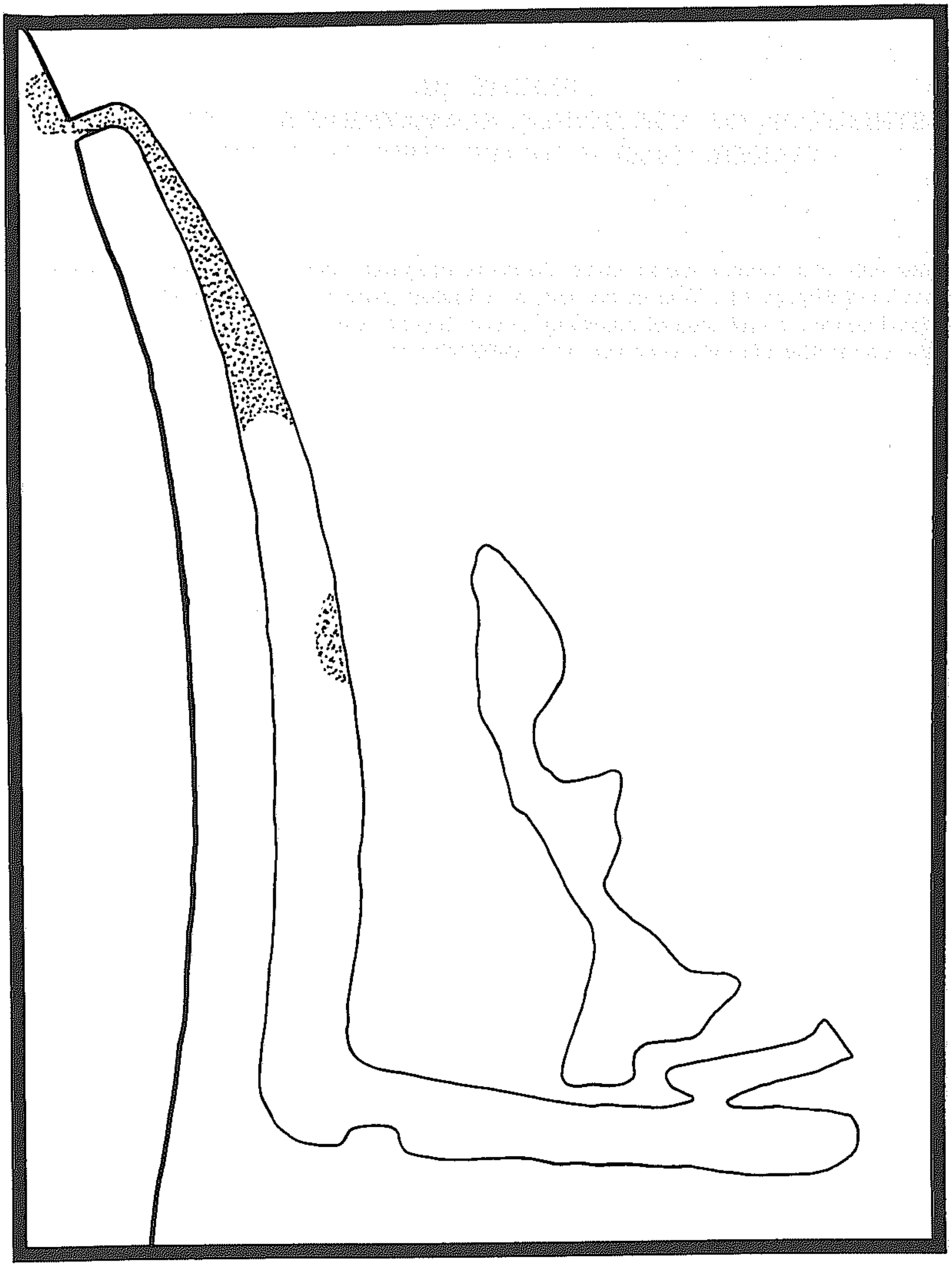


F34

FIGURE 18.
DISTRIBUTION OF *VORTICIFEX KLAMATHENSIS KLAMATHENSIS* (BAKER, 1945) IN HAGELSTEIN PARK AREA.

Areas with this medium-sized snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in limited areas of the north half of the west channel and in a small area of adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D13.

Vorticifex klamathensis klamathensis **(Baker, 1945)**

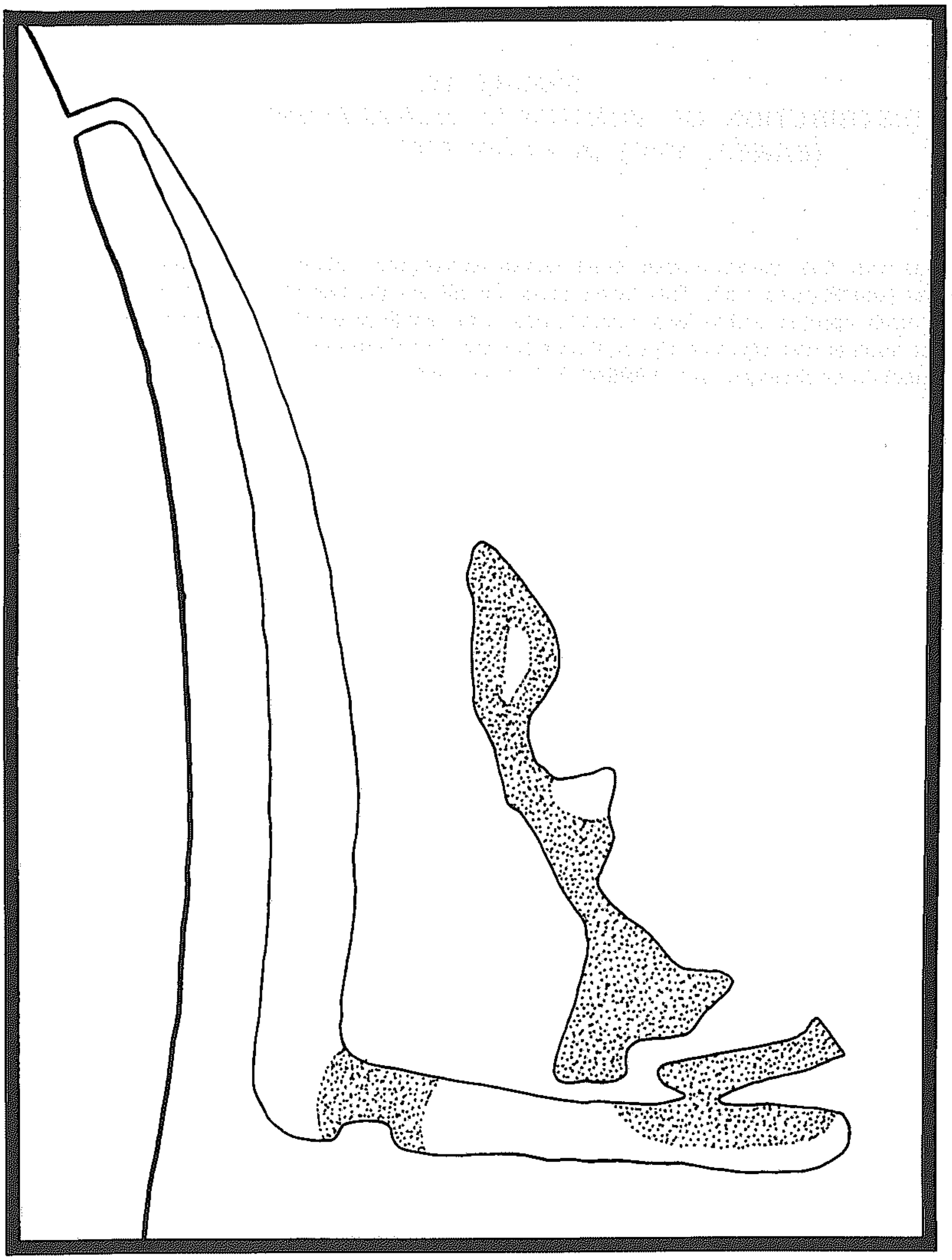


F36

FIGURE 19.
DISTRIBUTION OF *VORTICIFEX KLAMATHENSIS SINITSINI* (BAKER, 1945) IN HAGELSTEIN PARK AREA.

Areas with this medium-sized snail shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in all but the lowest water quality areas in the north springs and in less muddy areas of the south channel. Note absence from the west channel and adjoining Upper Klamath Lake. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D13.

Vorticifex klamathensis sinitsini (Baker, 1945)

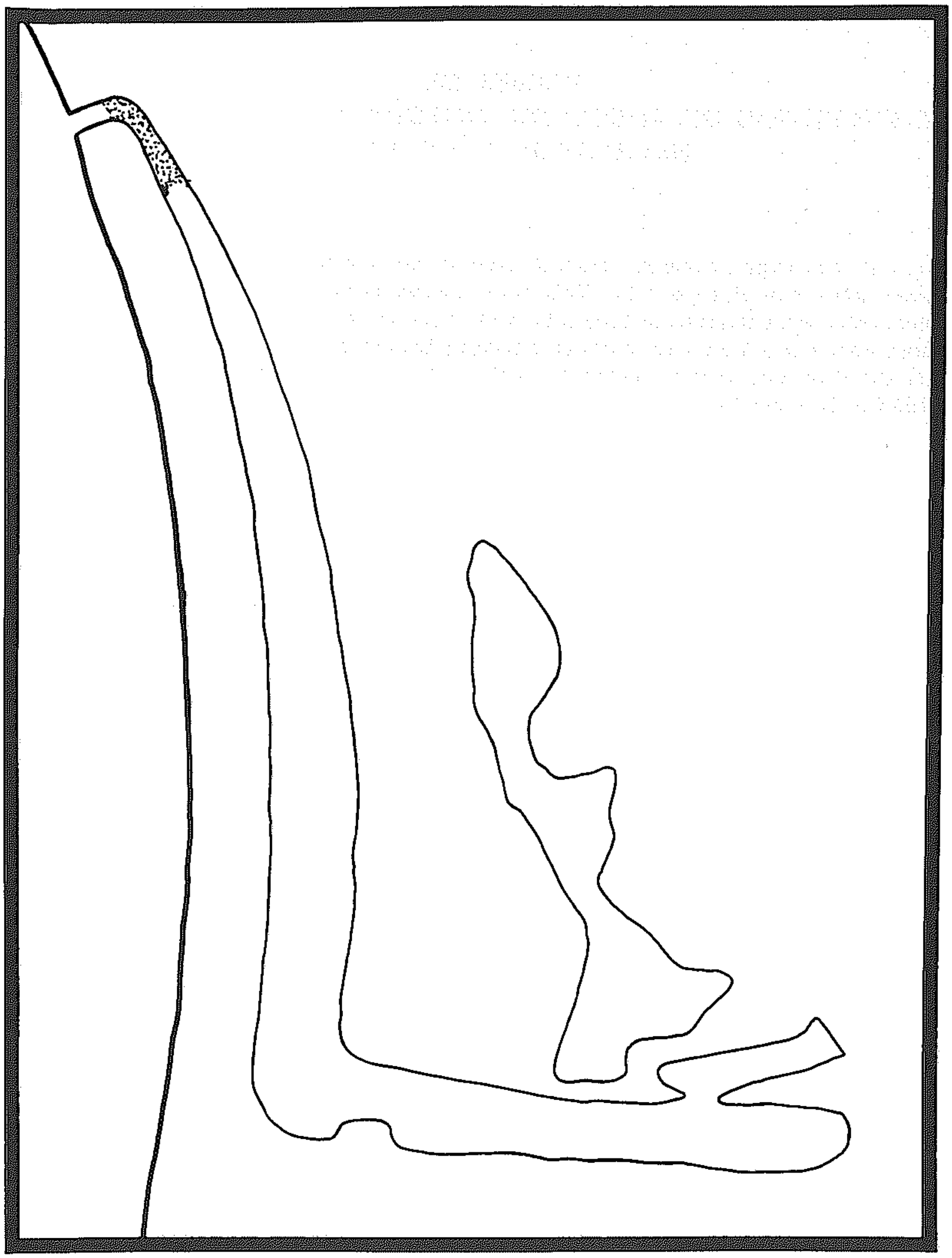


F38

FIGURE 20.
DISTRIBUTION OF *ANODONTA OREGONENSIS* LEA, 1838 IN HAGELSTEIN PARK AREA.

Areas with this large freshwater mussel taxon shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in only a small portion of the northernmost west channel, an area with swift flow and strong spring influence. Note absence from most of the west channel; adjoining Upper Klamath Lake; and the springs areas and their runs. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D14.

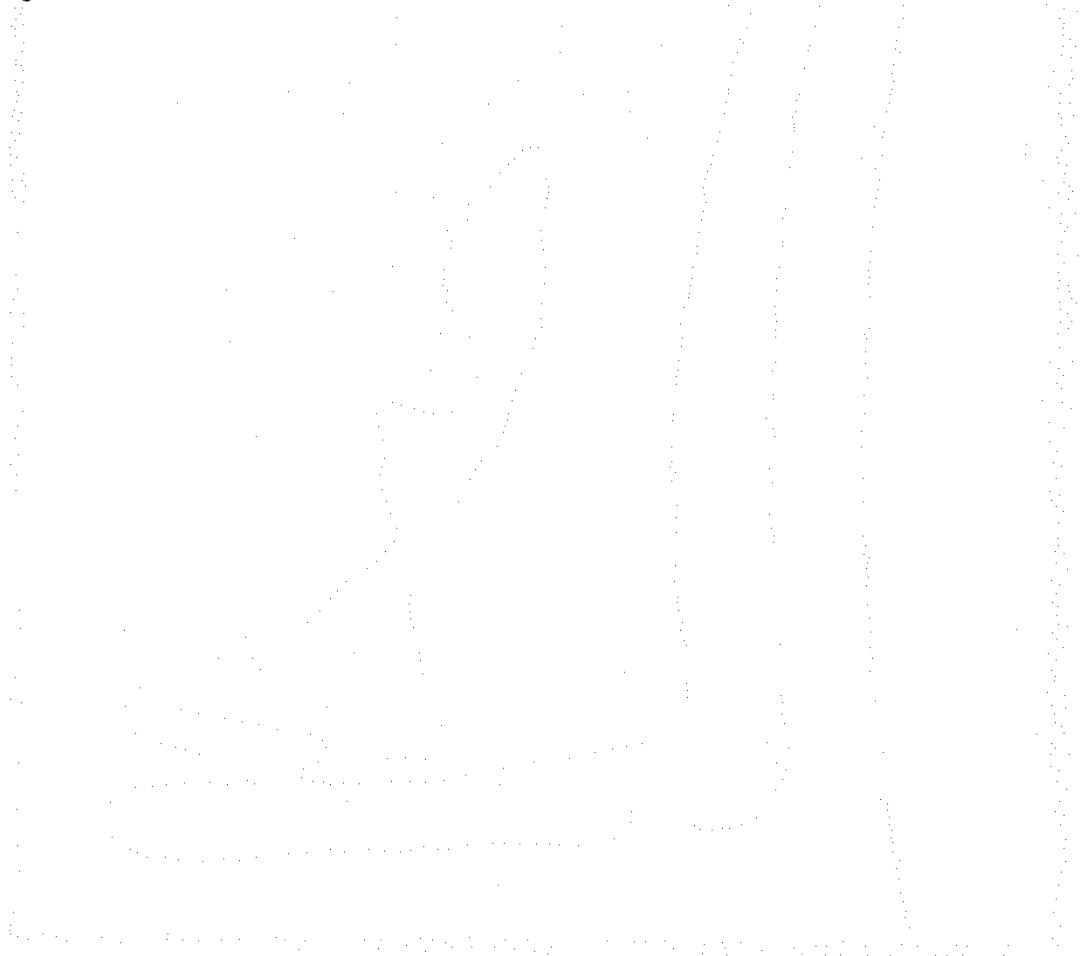
Anodonta oregonensis Lea, 1838



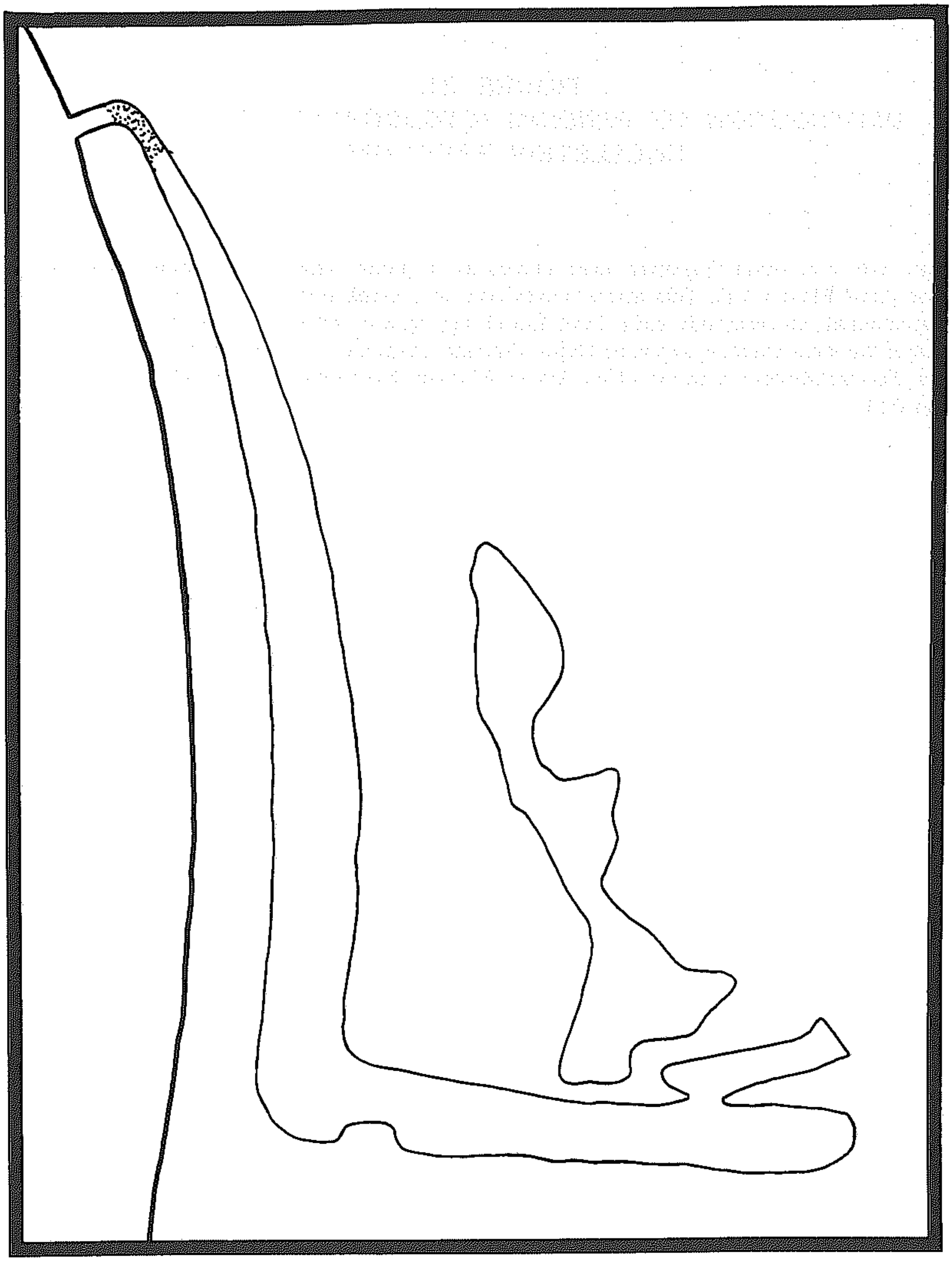
F40

FIGURE 21.
DISTRIBUTION OF *PISIDIUM (CYCLOCALYX)* N. SP. 1 IN HAGELSTEIN PARK AREA.

Areas with this small fingernail clam shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs only in a small portion of the northernmost west channel, an area with swift flow and strong spring influence. Note absence from most of the west channel; adjoining Upper Klamath Lake; and the springs areas and their runs. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D15.



Pisidium (Cyclocalyx) n. sp. 1

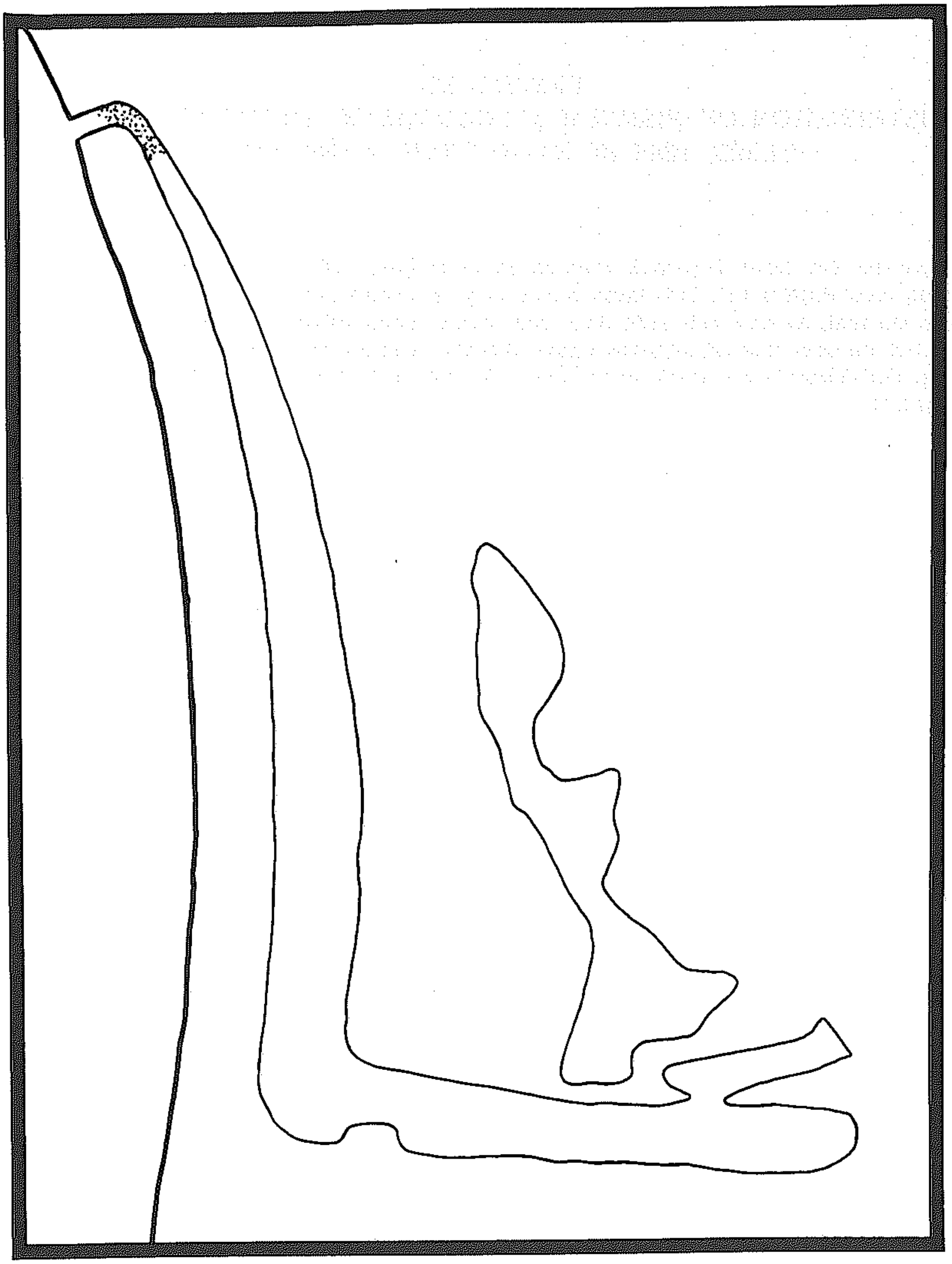


F42

FIGURE 22.
DISTRIBUTION OF *PISIDIUM (CYCLOCALYX) ULTRAMONTANUM* PRIME, 1865 IN HAGELSTEIN PARK AREA.

Areas with this small fingernail clam shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs only in a small portion of the northernmost west channel, an area with swift flow and strong spring influence. Note absence from most of the west channel; adjoining Upper Klamath Lake; and the springs areas and their runs. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D16.

Pisidium (Cyclocalyx) ultramontanum **Prime, 1865**

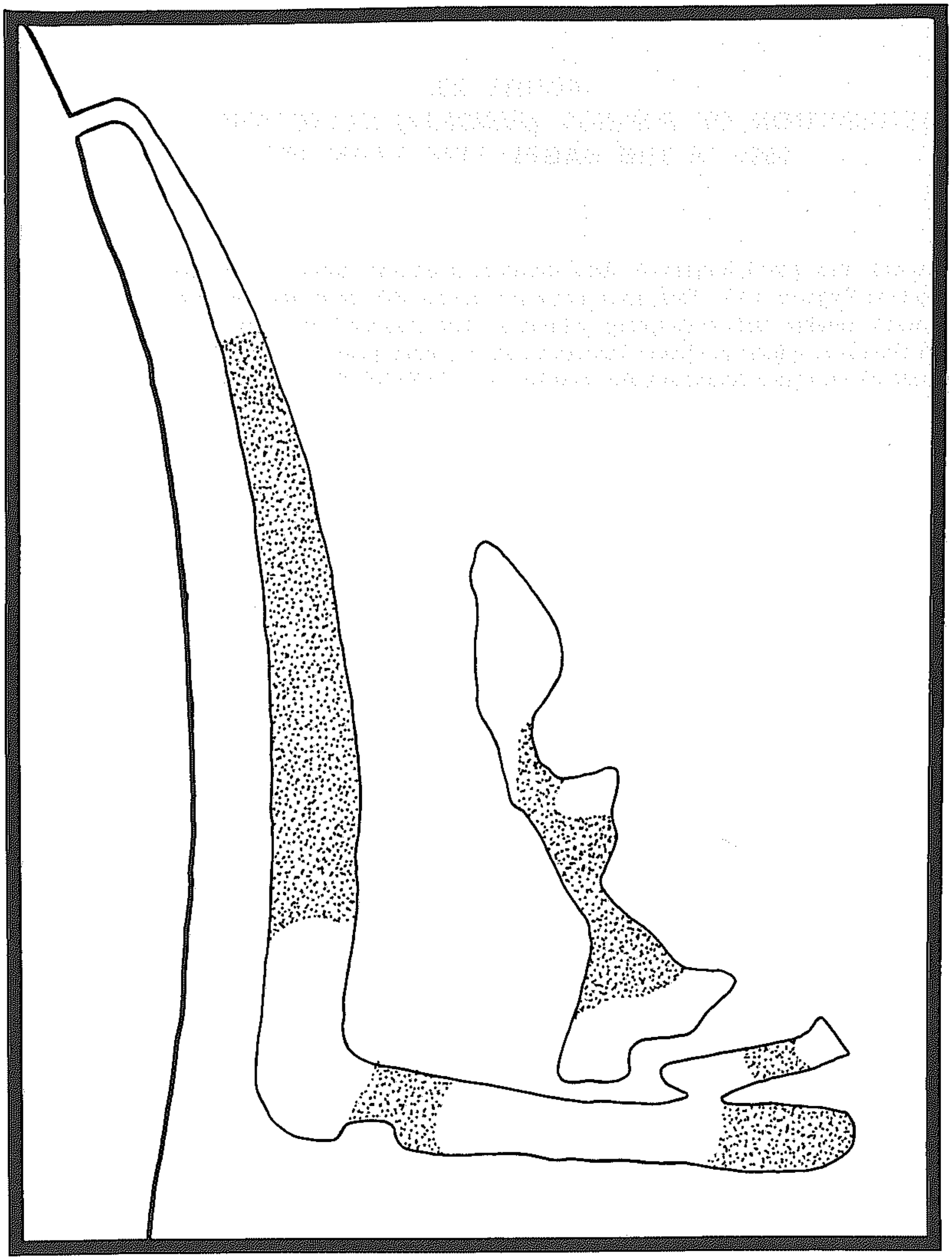


F44

FIGURE 23.
DISTRIBUTION OF *PISIDIUM (PISIDIUM) IDAHOENSE* ROPER, 1890 IN THE HAGELSTEIN PARK AREA.

Areas with this small fingernail clam shown as irregular stipple in normally watered areas (see **Figure 11**). This taxon occurs in areas with relatively soft substrate but good water quality and some spring influence. Note absence from parts of the west and south channels; adjoining Upper Klamath Lake; and spring source areas. For distribution in whole of the Upper Klamath Lake drainage, see **APPENDIX D**, page D17.

Pisidium (Pisidium) idahoense **Roper, 1890**



F46

TABLES

TABLE 1. FRESHWATER MOLLUSKS OF THE UPPER KLAMATH DRAINAGE.

SPECIES	HABITAT
GASTROPODA	
Valvata humeralis Say, 1829	perennial water bodies, rivers
Juga (Oreobasis) nigrina (Lea, 1856)	smaller perennial streams, springs
Juga (Oreobasis) "nigrina" Frest & Johannes, 1995b	large springs and larger streams
Pyrgulopsis archimedis Berry, 1947	spring-influenced area in large lake
Pyrgulopsis n. sp. 1 Frest & Johannes, 1995a 6, 16	large springs and spring-fed creeks, lakes
Pyrgulopsis n. sp. 2 Frest & Johannes, 1995a 29, 40	large and small springs
Lyogyrus n. sp. 3 Frest & Johannes, 1995a	large spring-fed lakes or rivers
Lyogyrus n. sp. 4 Frest & Johannes, 1995a	large spring-fed lake
Lyogyrus n. sp. 5 Frest & Johannes, 1995a	large springs or spring-fed streams
Fluminicola n. sp. 1 Frest & Johannes, 1995a	spring-influenced rivers, large springs
Fluminicola n. sp. 2 Frest & Johannes, 1995a	small springs
Fluminicola n. sp. 3 Frest & Johannes, 1995a	spring sources or small springs
Fluminicola n. sp. 7 Frest & Johannes, 1995a	larger springs
Fluminicola n. sp. 8 Frest & Johannes, 1995a	larger springs
Fluminicola n. sp. 9 Frest & Johannes, 1995a	small springs
Fluminicola n. sp. 16 Frest & Johannes, 1995a	small springs and spring-fed streams
Fluminicola n. sp. 27 Frest & Johannes, 1996a	large springs, spring-influenced streams
Fluminicola n. sp. 28 Frest & Johannes, 1996a	spring-fed creek
Fluminicola n. sp. 29 Frest & Johannes, 1996a	springs
Fluminicola n. sp. 30 Frest & Johannes, 1996a	springs
Fluminicola n. sp. 31 Frest & Johannes, 1996a	springs and spring-fed creeks or rivers
Fluminicola n. sp. 42 Frest & Johannes, 1998	springs and spring-fed creeks
**Radix auricularia* (Linnaeus, 1758)	widespread, often w/ abundant macrophytes
Lymnaea stagnalis appressa Say, 1821	lakes, ponds, slow streams
Stagnicola (Hinkleyia) caperata (Say, 1829)	small water bodies seasonally dry
Stagnicola (Hinkleyia) montanensis (Baker, 1913)	small flowing water bodies, seasonally dry
Stagnicola (Stagnicola) elodes Say, 1821)	water bodies and slow streams
Fossaria (Bakerilymnaea) bulimoides (Lea, 1841)	seeps and small streams
Fossaria (Fossaria) modicella (Say, 1825)	shallow water, amphibious along stream edges
Fossaria (Fossaria) parva (Lea, 1841)	amphibious around small water bodies
**Psuedosuccinea columella* (Say, 1817)	almost ubiquitous in warmer waters
Lanx alta (Tryon, 1865)	large-medium rivers, ? large spring pools
Lanx klamathensis Hannibal, 1912	large spring-fed lakes, large spring pools
Gyraulus (Armiger) crista (Linnaeus, 1758)	permanent ponds, lakes
Gyraulus (Torquis) parvus (Say, 1816)	almost ubiquitous
Helisoma (Carinifex) newberryi newberryi (Lea, 1858)	spring-influenced lakes, rivers, & creeks
Planorbella (Pierosoma) subcrenata (Carpenter, 1857)	slow streams, water bodies at high elevations
Planorbella (Pierosoma) tenuis (Dunker, 1850)	slow streams, water bodiies
Vorticifex effusus dalli (Baker, 1945)	well-oxygenated lakes, springs, streams
Vorticifex effusus diagonalis (Henderson 1929)	well-oxygenated lakes, springs, streams
Vorticifex effusus effusus (Lea, 1856)	well-oxygenated lakes, springs, streams
Vorticifex klamathensis klamathensis (Baker, 1945)	well-oxygenated lakes, springs, streams
Vorticifex klamathensis sinitsini (Baker, 1945)	larger springs and their outflows
Menetus (Menetus) callioglyptus (Vanatta, 1895)	lakes and streams
Promenetus exacuous exacuous (Say, 1821)	perennial seeps, small springs, & ponds
Promenetus umbilicatellus (Cockerell, 1887)	seasonal ponds, ditches, marshes
Ferrissia rivularis (Say, 1817)	almost ubiquitous in well-oxygenated water
Physa (Physa) skinneri Taylor, 1954	Mostly in marshes, ponds
Physella (Physella) gyrina (Say, 1821)	almost ubiquitous
Physella (Physella) lordi (Baird, 1842)	Western US, especially coastal-Cascades
Physella (Costatella) virgata (Gould, 1855)	oligotrophic habitats

TABLE 1. FRESHWATER MOLLUSKS OF THE UPPER KLAMATH DRAINAGE. (cont.)

SPECIES	HABITAT
BIVALVIA	
Anodonta californiensis Lea, 1852	lakes, rivers
Anodonta oregonensis Lea, 1838	lakes, rivers
Anodonta wahlametensis Lea, 1838	lakes, larger rivers
Gonidea angulata (Lea, 1838)	large creeks, rivers, rarely lakes
Margaritifera falcata (Gould, 1850)	rivers, large creeks
**Corbicula fluminea* (Müller, 1774)	artificial or disturbed water bodies, streams
Sphaerium occidentale (Lewis, 1856)	swamps, areas which may dry part of the year
Sphaerium patella (Gould, 1850)	perennial lakes and streams
Sphaerium striatinum (Lamarck, 1818)	creeks, rivers, lakes
Musculium raymondi (Cooper, 1890)	perennial water bodies
Musculium securis (Prime, 1852)	fluctating perennial water bodies
Pisidium (Pisidium) idahoense Roper, 1890	large cold springs
Pisidium (Cyclocalyx) casertanum (Poli, 1791)	seasonal and perennial water bodies
Pisidium (Cyclocalyx) compressum Prime, 1852	perennial creeks and rivers
Pisidium (Cyclocalyx) contortum Prime, 1854	perennial lakes and ponds
Pisidium (Cyclocalyx) pauperculum Sterki, 1896	perennial rivers, large spring-fed creeks
Pisidium (C.) ultramontanum Prime, 1865	spring-fed lakes and large streams
Pisidium (C.) n. sp. 1 Frest & Johannes ,1995a	spring-fed lakes and large streams
Pisidium (Cyclocalyx) variabile Prime, 1852	perennial streams
Pisidium (Cyclocalyx) ventricosum Prime, 1851	seasonally fluctuating water bodies
Pisidium (Neopisidium) insigne Gabb, 1868	perennial seeps, small springs
Pisidium (Neopisidium) punctatum Sterki, 1895	low-gradient rivers, large spring runs

*= introduced species

TABLE 2. STATUS OF UPPER KLAMATH MOLLUSKS.

SPECIES	STATUS			
	NSO	ROD[2]	ICS[3]	FED[4]
FRESHWATER GASTROPODA				
Pyrgulopsis archimedis Berry, 1947	Sp, E	-	S, E	-
Pyrgulopsis n. sp. 1 Frest & Johannes, 1995a	Sp, E	-	S, E	-
Pyrgulopsis n. sp. 2 Frest & Johannes, 1995a	-	-	S, E	-
Lyogyrus n. sp. 3 Frest & Johannes, 1995a	Sp, E	-	S, E	-
Lyogyrus n. sp. 4 Frest & Johannes, 1995a	Sp, E	-	S, E	-
Lyogyrus n. sp. 5 Frest & Johannes, 1995a	Sp, E	-	S, E	-
Fluminicola n. sp. 1 Frest & Johannes, 1995a	Sp, E	yes	S, E	-
Fluminicola n. sp. 2 Frest & Johannes, 1995a	Sp, E	yes	S, E	-
Fluminicola n. sp. 3 Frest & Johannes, 1995a	Sp, E	yes	S, E	-
Fluminicola n. sp. 7 Frest & Johannes, 1995a	-	-	S, T	-
Fluminicola n. sp. 8 Frest & Johannes, 1995a	-	-	S, E	-
Fluminicola n. sp. 9 Frest & Johannes, 1995a	-	-	S, E	-
Stagnicola (Hinkleyia) montanensis (Baker, 1913)	-	-	W	-
Lanx alta (Tryon, 1865)	Sp, T	-	S, E	-
Lanx klamathensis Hannibal, 1912	Sp, E	-	S, E	-
Helisoma (Carinifex) newberryi newberryi (Lea, 1858)	Sp, E	-	S, E	-
Vorticifex effusus dalli (Baker, 1945)	-	-	S, E	-
Vorticifex effusus diagonalis (Henderson, 1929)	-	-	S, E	-
Vorticifex klamathensis klamathensis (Baker, 1945)	Sp, E	-	S, E	-
Vorticifex klamathensis sinitsini (Baker, 1945)	Sp, E	yes	S, E	-

SPECIES	STATUS			
	NSO	ROD[2]	ICS[3]	FED[4]
TERRESTRIAL GASTROPODA				
Discus shimeki cockerelli (Pilsbry, 1898)	-	-	-	C2
Monadenia (Monadenia) n. sp. 1 Frest & Johannes, 1995a	-	-	S, E	-
Pristiloma arcticum? crateris Pilsbry, 1946	Sp, T	yes	S, T	-
Vespericola sierranus (Berry, 1921)	Sp, T	-	S, T	-

TABLE 2. STATUS OF UPPER KLAMATH MOLLUSKS (cont.).

SPECIES	STATUS			
	NSO[1]	ROD[2]	ICB[3]	FED[4]
BIVALVIA				
Anodonta californiensis Lea, 1852	Sp, E	-	S, T	C2
Anodonta oregonensis Lea, 1838	-	-	-	-
Anodonta wahlametensis Lea, 1838	Sp, E	-	S, E	-
Gonidea angulata (Lea, 1838)	-	-	W	-
Margaritifera falcata (Gould, 1850)	-	-	W	-
Pisidium (C.) ultramontanum Prime, 1865	Sp, E	-	S, E	C2
Pisidium (C.) n. sp.1	-	-	S, E	-

EXPLANATION:

C2 = Federal ESA category 2 candidate: see USFWS (1994)
E = Recommended for federal ESA listing as Endangered; see Frest & Johannes (1993, 1995a)
S = Sensitive species; see Frest & Johannes (1995a)
Sp = Species of Special Concern; see Frest & Johannes (1993)
T = Recommended for federal ESA listing as Threatened; see Frest & Johannes (1993, 1995a)
W = Watch List; see Frest & Johannes (1995a)

1 = Mollusc Species of Special Concern Within the Range of the Northern Spotted Owl (Frest & Johannes, 1993)
2 = Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (ROD, 1994)
3 = Interior Columbia Basin Mollusk Species of Special Concern (Frest & Johannes, 1995a)
4 = Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species; Proposed Rule (USFWS, 1994)

= Tracking • = Recovery in BCD

97
98
99

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS.

195-206 15

TAXON NAME	SITE NUMBER 1	2	3	4	5	6	7	8	9	10	11
Ferrissia rivularis											
Fluminicola n. sp. 1 Klamath									x001	x001	
Fluminicola n. sp. 2 tall											
Fluminicola n. sp. 3 Klamath											
Fluminicola n. sp. 7 Tiger lily											
Fluminicola n. sp. 8 Lost river											
Fluminicola n. sp. 9 Wood River	x005	x003	x007	x001							
Fluminicola n. sp. 16 Keene Cr							002				
Fluminicola n. sp. 27 Crooked creek	x007	x005	x009		x010		x	x011			
Fluminicola n. sp. 28 Odessa											
Fluminicola n. sp. 29 Oaxy Spr											
Fluminicola n. sp. 30 Casebeer											
Fluminicola n. sp. 31 Lake of the											
Fluminicola n. sp. 42 Duncan											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus			new	001			x				
Helisoma (C.) newberryi Great			x								
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											x
Lanx alta highcap lanx								x001			
Lanx klamathensis Scale lanx			x004			x	x002				
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3 Klamath					x002	x001	new				
Lyogyrus n. sp. 4 nodose							x		001		
Lyogyrus n. sp. 5 mare's egg	x002							.003	x		
Menetus (M.) callioglyptus			x								
Physa (Physa) skinneri glass											
Physella (Costatella) virgata											
Physella (Physella) gyrina			x							x	
Physella (Physella) lordi							x				
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis Archim						x002					
Pyrgulopsis n. sp. 1 Kla. Lake						x002					
Pyrgulopsis n. sp. 2 (Big Spring ?)		LOST	RIVER								
**Radix auricularia*											
Stagnicola (H.) caperata							x				
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli Dalls						x001					
Vorticifex effusus diagonalis											
Vorticifex effusus effusus			x							x	
Vorticifex k. klamathensis						x001					
Vorticifex k. sinitsini Sinitsin							x001				

pebblesnails

duskysnails

New EL code =

Springsnail

rams-horns

MOVING THIS SITE FROM DOTNUM 8 → NOW WILL BE INCLUDED WITH RIVER EOR (DOTNUM 15)

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

9 17 16

TAXON NAME	SITE NUMBER										
	12 2	13	14	15 1	16 5	17	18	19	20 4	21 5	22
Ferrissia rivularis											
Fluminicola n. sp. 1				x002	x007	x007					
Fluminicola n. sp. 2											
Fluminicola n. sp. 3	x001										
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27 Crooke[illegible]											
Fluminicola n. sp. 28									x001	x002	
Fluminicola n. sp. 29					x001						
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista					002						
Gyraulus (T.) parvus				new							
Helisoma (C.) newberryi				x							
Juga (Oreobasis) "nigrina"							x				
Juga (Oreobasis) nigrina	x	x	x								
Lanx alta										002	
Lanx klamathensis										x	
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4				x001	x002	x002					
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata									x		
Physella (Physella) gyrina		[x]		x			x	x			
Physella (Physella) lordi											
Planorbella (P.) subcrenata								x			
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis				x001	x 003	x003					
Pyrgulopsis n. sp. 1				x001							
Pyrgulopsis n. sp. 2											
**Radix auricularia*								x			
Stagnicola (H.) caperata								x			
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli				x002							
Vorticifex effusus diagonalis											
Vorticifex effusus effusus					x?				x		
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

mistake?

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	23 ⊕5	24 ⊕14	25	26 ⊕2	27	28 ⊕1	29 ⊕1	30 ⊕1	31	32	33
Ferrissia rivularis											
Fluminicola n. sp. 1 Klamath		x003									
Fluminicola n. sp. 2 tall	x001										
Fluminicola n. sp. 3 Kla. rim											
Fluminicola n. sp. 7 Tiger											
Fluminicola n. sp. 8 Lost riv											
Fluminicola n. sp. 9 Wood riv											
Fluminicola n. sp. 16 Keene											
Fluminicola n. sp. 27 Crk crk											
Fluminicola n. sp. 28 Odessa	x003										
Fluminicola n. sp. 29 Ouxy Sp.											
Fluminicola n. sp. 30 Casebeer											
Fluminicola n. sp. 31 Lake o Wood							002				
Fluminicola n. sp. 42							x	x			
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus		003 new									
Helisoma (C.) newberryi		x									
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis	x005	x006		x001							
Lymnaea stagnalis appressa		x									
Lyogyrus n. sp. 3 klamath											
Lyogyrus n. sp. 4 nodose		005									
Lyogyrus n. sp. 5 mare	x004	x									
Menetus (M.) callioglyptus			x								
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina		x				x					
Physella (Physella) lordi											
Planorbella (P.) subcrenata		x									
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1 Klamath lake											
Pyrgulopsis n. sp. 2							x001				
**Radix auricularia*											
Stagnicola (H.) caperata		x									
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus	x	x?	x				x	x			
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.). combine

37 36 √ mapping & location

TAXON NAME	SITE NUMBER										
	34	35	36	37	38	39	40	41	42	43	44
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7			x004	x004	x005	x003	x001		x002	x002	x002
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28					x004						
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides				x							
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus											
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus			x	x		x		x			
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina											
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus						x					
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

combined

TAXON NAME	SITE NUMBER										
	45 ⊕7	46	47 ⊕13	48 ⊕3	49 ⊕7	50	51	52	53 ⊕2	54 ⊕4	55
Ferrissia rivularis											
Fluminicola n. sp. 1 Klamath											
Fluminicola n. sp. 2 tall											
Fluminicola n. sp. 3 Kl. rim											
Fluminicola n. sp. 7 Tiger											
Fluminicola n. sp. 8 Lost riv											
Fluminicola n. sp. 9 Wood riv	x004	x004	x006		x002	x002	x002			x009	
Fluminicola n. sp. 16 Keene									.013		
Fluminicola n. sp. 27 crk crk	x006	x006	x006	x012	x009	x004	x004	x004	x	x014	
Fluminicola n. sp. 28 odessa											
Fluminicola n. sp. 29 Ouxy											
Fluminicola n. sp. 30 Case beer											
Fluminicola n. sp. 31 Lake o Wood											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus											
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3 Klamath											
Lyogyrus n. sp. 4 no dose											
Lyogyrus n. sp. 5 mares						x001		x?001			
Menetus (M.) callioglyptus			x	x		x		x			
Physa (Physa) skinneri											
Physella (Physella) gyrina				x							
Physella (Physella) lordi											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus										x	
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1 Kla. lake											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata				x							
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli									002		
Vorticifex effusus diagonalis						x001			x	x003	
Vorticifex effusus effusus	x	x	x		x			x?			
Vorticifex k. klamathensis											
Vorticifex k. sinitsini				x?002							

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).
combine

TAXON NAME	SITE NUMBER										
	56	57	58	59	60	61	62	63	64	65	66
Ferrissia rivularis											
Fluminicola n. sp. 1		x004									x005
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											x006
Fluminicola n. sp. 8											
Fluminicola n. sp. 9							x008	x008	move	x010	
Fluminicola n. sp. 16											
Fluminicola n. sp. 27									x003	x015	
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyrauls (A.) crista											
Gyraulus (T.) parvus											new 004
Helisoma (C.) newberryi											x
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina									new		
Lanx alta									x?		
Lanx klamathensis		x007									
Lymnaea stagnalis appressa									new		
Lyogyrus n. sp. 3									x		
Lyogyrus n. sp. 4											007
Lyogyrus n. sp. 5											x
Menetus (M.) callioglyptus											x
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina	x	x							x		x
Physella (Physella) lordi											
Planorbella (P.) subcrenata	x										
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus										x	
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*	x	x									
Stagnicola (H.) caperata	x	x									x
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis	x	x									
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus		x?							x	x?	
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	67	68	69	70	71	72	73	74	75	76	77
Ferrissia rivularis											
Fluminicola n. sp. 1 Klamath	x006										
Fluminicola n. sp. 2 tall											
Fluminicola n. sp. 3 Kla. rim											
Fluminicola n. sp. 7 tiger		x007	x008	x009	x010						
Fluminicola n. sp. 8 Lost riv											
Fluminicola n. sp. 9 wood riv											
Fluminicola n. sp. 16 Keene											
Fluminicola n. sp. 27 crk crk											
Fluminicola n. sp. 28 Odessa											
Fluminicola n. sp. 29 Duxin											
Fluminicola n. sp. 30 Casebeer											
Fluminicola n. sp. 31 Lake o Woods								x004			x004
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella				x							
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus	006 new										
Helisoma (C.) newberryi	x										
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa	x										
Lyogyrus n. sp. 3 Klamath											
Lyogyrus n. sp. 4 nodose											
Lyogyrus n. sp. 5 mares											
Menetus (M.) callioglyptus	x	x									
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina	x										
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1 Kla. Lake											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis	x										
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus		002									
Vorticifex k. klamathensis	x?										
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	78	79 1	80 2	81	82	83	84	85	86	87	88 2
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8			x001								
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											x001
Fluminicola n. sp. 31		x005									
Fluminicola n. sp. 42			x								
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus			x								
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina		[x]		x	x		[x]				
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1			002								
Pyrgulopsis n. sp. 2			x								
**Radix auricularia*							[x]				
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes				x	x						
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus			x								
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.). w/ 7

TAXON NAME	SITE NUMBER										
	89	90	91	92	93	94 ⊕9	95 ⊕15	96 ⊕5	97 ⊕6	98	99 ⊕8
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9							x011				
Fluminicola n. sp. 16											
Fluminicola n. sp. 27							x016		x002	x 002	x002
Fluminicola n. sp. 28											
Fluminicola n. sp. 29								x001			
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus						x					
Helisoma (C.) newberryi										x	x
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina								x			
Lanx alta							x003				
Lanx klamathensis										x002	x 002
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3						x ?003					
Lyogyrus n. sp. 4										x	
Lyogyrus n. sp. 5									006	006	006
Menetus (M.) callioglyptus						x	x				
Physa (Physa) skinneri											
Physella (Costatella) virgata	x										
Physella (Physella) gyrina						x	x		x	x	
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus					x						
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata									x		
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis						x			x		
Vorticifex effusus dalli											
Vorticifex effusus diagonalis							x004				
Vorticifex effusus effusus						x					
Vorticifex k. klamathensis											
Vorticifex k. sinitsini										x001	x001

new

mistake

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.). combine w/ .64 + delete .017

TAXON NAME	SITE NUMBER										
	100	101	102	103	104	105	106	107	108	109	110
Ferrissia rivularis								change			
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9								.003			
Fluminicola n. sp. 16											
Fluminicola n. sp. 27							x .017				
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus											
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus							x				
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina	x						x				
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes							x				
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus	x						x				
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	111	112	113	114	115	116	117 ⊕13	118 ⊕4	119	120	121
Ferrissia rivularis							x				
Fluminicola n. sp. 1							008				
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27							x018	x019			
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus								x	x		
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta								x004			
Lanx klamathensis											
Lymnaea stagnalis appressa							x		x		
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina					[x]	x		x			
Physella (Physella) lordi											
Planorbella (P.) subcrenata							x		x		
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes								x	x		
Valvata humeralis								x	x		
Vorticifex effusus dalli											
Vorticifex effusus diagonalis						x005					
Vorticifex effusus effusus							x	x			
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

combined

TAXON NAME	SITE NUMBER 122	123	124	125	126	127	128	129	130	131	132
Ferrissia rivularis											
Fluminicola n. sp. 1						x009	x010	x010	x011		
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella					x						
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus				x	x		x	x			x
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4						x003					
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina						x	x	x	x		
Physella (Physella) lordi											
Planorbella (P.) subcrenata							x		x		
Planorbella (P.) tenuis											
Promenetus exacuous							x				
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis							x004	x004			
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*							x				
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											x
Stagnicola (Stagnicola) elodes											
Valvata humeralis							x				
Vorticifex effusus dalli									x003		
Vorticifex effusus diagonalis											
Vorticifex effusus effusus											
Vorticifex k. klamathensis						x003		x004	x005		
Vorticifex k. sinitsini											

w/ 209+210

delete + combine w/ others site #6

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

w/ 144,145

TAXON NAME	SITE NUMBER										
	133	134	135	136	137	138	139	140	141	142	143
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8										x 001	x 00
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31			.007				.010				
Fluminicola n. sp. 42		x	x	x	x		x			x	
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella			x								
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus						x	x			x	x
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata		x	x	x							
Physella (Physella) gyrina	x									x	x
Physella (Physella) lordi											
Planorbella (P.) subcrenata										x	x
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											003
Pyrgulopsis n. sp. 2											x
**Radix auricularia*	x					x	x			x	x
Stagnicola (H.) caperata										x	
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes	x					x	x			x	x
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus										[x]	x
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

142, 143, wl #80

TAXON NAME	SITE NUMBER										
	144	145	146	147	148	149	150	151	152	153	154
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8	x 001	x 001									
Fluminicola n. sp. 9								.001			
Fluminicola n. sp. 16								x			
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31	.003					x 006	x 011				
Fluminicola n. sp. 42	x	x									
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus	x	x									
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina	x	x									
Physella (Physella) lordi											
Planorbella (P.) subcrenata	x	x									
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2	x 002	x 002									
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus		x									
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	155 ⊕14	156 ⊕15	157 ⊕2	158	159	160	161	162 ⊕1	163	164	165
Ferrissia rivularis											
Fluminicola n. sp. 1			x012								
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7	x011	x012						x013			
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus			x	006 new							
Helisoma (C.) newberryi				x							
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus				x							
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina			x	x							
Physella (Physella) lordi											
Planorbella (P.) subcrenata			x								
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis			x005								
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*			x	x							
Stagnicola (H.) caperata			x	x							
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis			x								
Vorticifex effusus dalli			x004								
Vorticifex effusus diagonalis											
Vorticifex effusus effusus				007							
Vorticifex k. klamathensis			x006	x							
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	166 ⊕ E	167	168	169	170	171	172	173	174	175	176
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3	014										
Fluminicola n. sp. 7	x										
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus											
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina											
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus	x										
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus											
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

combine w/ 212-215 294 295

TAXON NAME	SITE NUMBER										
	177	178	179	180	181	182	183 ?	184	185	186	187
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30							.009				
Fluminicola n. sp. 31							~~x~~				
Fluminicola n. sp. 42							x				
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus											
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											x
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina							x				
Physella (Physella) lordi											
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											x new
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata											
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis											
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus											
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

New Sites

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

combine w/ 7 97 + 98

TAXON NAME	SITE NUMBER 188	189	190	191	192	193	194	195	195	197	198
Ferrissia rivularis			new								
Fluminicola n. sp. 1			x								
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27				x	x	x		x^{002}	x^{002}	x^{002}	x^{002}
Fluminicola n. sp. 28											
Fluminicola n. sp. 29					combine		- new				
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus		x		x	x	x		x	x		
Helisoma (C.) newberryi				x	x	x		x	x	x	x
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina					comb	- new					
Lanx alta											
Lanx klamathensis								x^{002}	x^{002}		
Lymnaea stagnalis appressa						x					
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata					x	x					
Physella (Physella) gyrina				x	x	x				x	
Physella (Physella) lordi				x	x	x		x	x	x	x
Planorbella (P.) subcrenata					x	x					
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus			new								
**Psuedosuccinea columella*											
Pyrgulopsis archimedis		x	x								
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*						x					
Stagnicola (H.) caperata				x	x	x			x	x	x
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis		x	x	x	x	x					x
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus				x	combine					x	
Vorticifex k. klamathensis		x	x								
Vorticifex k. sinitsini					x	x	- new	x^{001}	x^{001}	x^{001}	x^{001}

Ex. 280-US-410
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TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

combine w/ 7

TAXON NAME	SITE NUMBER										
	199	200	201	202	203	204	205	206	207	208	209
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27	x 002	x 002	x 002	x 002	x 002	x 002	x 002	x 002	x 002	x 002	x new overlay
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus	x	x					x				x
Helisoma (C.) newberryi	x	x	x	x	x		x	x		x	
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis			x 002	x 002	x 002	x 002					
Lymnaea stagnalis appressa			x							x	
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4				x		x					
Lyogyrus n. sp. 5	006										
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina		x	x					x	x	x	
Physella (Physella) lordi	x	x	x	x	x		x	x	x	x	x
Planorbella (P.) subcrenata		x									
Planorbella (P.) tenuis											
Promenetus exacuous									x		
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											x -004
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*		x								x	
Stagnicola (H.) caperata	x	x	x		x				x	x	
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis	x	x	[o]					x			x
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus											
Vorticifex k. klamathensis									x new		x .004
Vorticifex k. sinitsini	x 001	x 001	x 001	x 001	x 001	x 001	x 001	x 001	x 001	x 001	

combine w/ 128+129

combine 128, 129, 209

295

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

combine 187 294

TAXON NAME	SITE NUMBER										
	210	211	212	213	214	215	216	217	218	219	220
Ferrissia rivularis	.010								.011		.011
Fluminicola n. sp. 1	x								x		x
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16	new										
Fluminicola n. sp. 27	x										
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus							x				
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"					x	x					
Juga (Oreobasis) nigrina											
Lanx alta		new									
Lanx klamathensis		x					[o]		x		
Lymnaea stagnalis appressa							.001		.001		
Lyogyrus n. sp. 3							x		x		
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina											x
Physella (Physella) lordi	x	x					x		x	x	x
Planorbella (P.) subcrenata											[o]
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*							002		002		
Pyrgulopsis archimedis							[o]		x		
Pyrgulopsis n. sp. 1			x	x	x	x					
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata	x										
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis	x	.001					x 001	001	x .001		001
Vorticifex effusus dalli		x					x	x	x		[o]
Vorticifex effusus diagonalis											
Vorticifex effusus effusus		.001					001	001	001		001
Vorticifex k. klamathensis		x					x	x	x		x
Vorticifex k. sinitsini											

combine w 6 Link River

combine w/ 6.

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

[combine w/ 28 new?

TAXON NAME	SITE NUMBER										
	221	222	223	224	225	226	227	228	229	230	231
Ferrissia rivularis			011								
Fluminicola n. sp. 1			x								
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7							new		new		
Fluminicola n. sp. 8							x		x		
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella								x			
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus		x				[x]			x		
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta			new								
Lanx klamathensis			x ✓								
Lymnaea stagnalis appressa			001								
Lyogyrus n. sp. 3			x								
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina									x		x
Physella (Physella) lordi			x								
Planorbella (P.) subcrenata		x					x		x		
Planorbella (P.) tenuis											
Promenetus exacuous		x									
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1							new		new		
Pyrgulopsis n. sp. 2							x		x		
**Radix auricularia*						[x]	x		x		x
Stagnicola (H.) caperata									x		
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											x
Valvata humeralis		x	001						x		
Vorticifex effusus dalli			x								
Vorticifex effusus diagonalis											
Vorticifex effusus effusus	001	new	001								
Vorticifex k. klamathensis	x	x	x								
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

NEW NEW

TAXON NAME	SITE NUMBER										
	232	233	234	235	236	237	238	239	240	241	242
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7	new						new				
Fluminicola n. sp. 8	x						x				
Fluminicola n. sp. 9											
Fluminicola n. sp. 16											
Fluminicola n. sp. 27											
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella	x					x	x				
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus	x	[o]	x				x				
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											
Physella (Physella) gyrina		x	x	x			x				
Physella (Physella) lordi											
Planorbella (P.) subcrenata			x	x			[o]				
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus											
**Psuedosuccinea columella*							x				
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1	new										
Pyrgulopsis n. sp. 2	x										
**Radix auricularia*	x		x	x			x				
Stagnicola (H.) caperata					[x]		x				
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis						x					
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus	[o]						x				
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

NEW NEW

TAXON NAME	SITE NUMBER										
	243	244	245	246	247	248	249	250	251	252	253
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7						new	new	new			
Fluminicola n. sp. 8						x	x	x			
Fluminicola n. sp. 9											
Fluminicola n. sp. 16										new	new
Fluminicola n. sp. 27										x	x
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42	x										
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella	x										
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus						x	x			x	
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata											x
Physella (Physella) gyrina							x			x	x
Physella (Physella) lordi											
Planorbella (P.) subcrenata						x					
Planorbella (P.) tenuis											
Promenetus exacuous						x					
Promenetus umbilicatellus											
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1						new	new	new			new
Pyrgulopsis n. sp. 2						x	x	x			x
**Radix auricularia*						x					
Stagnicola (H.) caperata						x					
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes						x					
Valvata humeralis						x	x	x			
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus								x		x	x
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

NEW

TAXON NAME	SITE NUMBER										
	254	255	256	257	258	259	260	261	262	263	264
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9											
Fluminicola n. sp. 16	NEW										
Fluminicola n. sp. 27	x										
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42								x			x
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista							x				
Gyraulus (T.) parvus	x					x	x				
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa							x				
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri							x				
Physella (Costatella) virgata					x	x					
Physella (Physella) gyrina											
Physella (Physella) lordi											
Planorbella (P.) subcrenata							x				
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus								x			x
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata							x				
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis	x						x				
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus	x										
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

combine

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

New row new

TAXON NAME	SITE NUMBER										
	265	266	267	268	269	270	271	272	273	274	275
Ferrissia rivularis											
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											
Fluminicola n. sp. 8											
Fluminicola n. sp. 9							new				new
Fluminicola n. sp. 16									new		
Fluminicola n. sp. 27							x	x	x	x	x
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42	x	x									
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista											
Gyraulus (T.) parvus								x	x	x	
Helisoma (C.) newberryi											
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina											
Lanx alta											
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3											
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus											
Physa (Physa) skinneri											
Physella (Costatella) virgata								x		x	x
Physella (Physella) gyrina								x	x	x	
Physella (Physella) lordi										x	
Planorbella (P.) subcrenata											
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus		x									
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1											
Pyrgulopsis n. sp. 2											
**Radix auricularia*											
Stagnicola (H.) caperata										x	
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes									x		
Valvata humeralis									x		
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus								x			
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

combine 274 | combine w/ 64

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	SITE NUMBER										
	275	277	278	279	280	281	282	283	284	285	286
Ferrissia rivularis			x								
Fluminicola n. sp. 1											
Fluminicola n. sp. 2											
Fluminicola n. sp. 3											
Fluminicola n. sp. 7											x new
Fluminicola n. sp. 8											
Fluminicola n. sp. 9						combine					
Fluminicola n. sp. 16	new		new	new	new				new	new	
Fluminicola n. sp. 27	x		x	x	x	x	x		x	x	
Fluminicola n. sp. 28											
Fluminicola n. sp. 29											
Fluminicola n. sp. 30											
Fluminicola n. sp. 31											
Fluminicola n. sp. 42											
Fossaria (B.) bulimoides											
Fossaria (Fossaria) modicella											
Fossaria (Fossaria) parva											
Gyraulus (A.) crista							new				
Gyraulus (T.) parvus	x		x	x							
Helisoma (C.) newberryi						x	x				
Juga (Oreobasis) "nigrina"											
Juga (Oreobasis) nigrina					new	new			new		
Lanx alta					x	x			x		
Lanx klamathensis											
Lymnaea stagnalis appressa											
Lyogyrus n. sp. 3				x							
Lyogyrus n. sp. 4											
Lyogyrus n. sp. 5											
Menetus (M.) callioglyptus					x						
Physa (Physa) skinneri											
Physella (Costatella) virgata	x										
Physella (Physella) gyrina					x						
Physella (Physella) lordi											
Planorbella (P.) subcrenata				x							
Planorbella (P.) tenuis											
Promenetus exacuous											
Promenetus umbilicatellus										x	
**Psuedosuccinea columella*											
Pyrgulopsis archimedis											
Pyrgulopsis n. sp. 1	new		new								
Pyrgulopsis n. sp. 2	x		x								
**Radix auricularia*											
Stagnicola (H.) caperata	x										
Stagnicola (H.) montanensis											
Stagnicola (Stagnicola) elodes											
Valvata humeralis	x		x	x							
Vorticifex effusus dalli											
Vorticifex effusus diagonalis											
Vorticifex effusus effusus	x		x	x	x	x			x	x	
Vorticifex k. klamathensis											
Vorticifex k. sinitsini											

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

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combine w/ 1

TAXON NAME	SITE NUMBER									
	287	288	289	290	291	292	293	294	295	296
Ferrissia rivularis										
Fluminicola n. sp. 1		x						x	x	x
Fluminicola n. sp. 2										
Fluminicola n. sp. 3										
Fluminicola n. sp. 7										
Fluminicola n. sp. 8										
Fluminicola n. sp. 9										
Fluminicola n. sp. 16										
Fluminicola n. sp. 27										
Fluminicola n. sp. 28										
Fluminicola n. sp. 29										
Fluminicola n. sp. 30										
Fluminicola n. sp. 31										
Fluminicola n. sp. 42										
Fossaria (B.) bulimoides										
Fossaria (Fossaria) modicella										
Fossaria (Fossaria) parva										
Gyraulus (A.) crista										
Gyraulus (T.) parvus										
Helisoma (C.) newberryi								x	x	x
Juga (Oreobasis) "nigrina"										
Juga (Oreobasis) nigrina										
Lanx alta										
Lanx klamathensis										
Lymnaea stagnalis appressa										
Lyogyrus n. sp. 3										
Lyogyrus n. sp. 4										
Lyogyrus n. sp. 5		x								
Menetus (M.) callioglyptus										
Physa (Physa) skinneri										
Physella (Costatella) virgata										
Physella (Physella) gyrina										
Physella (Physella) lordi		x							x	
Planorbella (P.) subcrenata										
Planorbella (P.) tenuis										
Promenetus exacuous										
Promenetus umbilicatellus										
*Psuedosuccinea columella										
Pyrgulopsis archimedis		x								
Pyrgulopsis n. sp. 1										
Pyrgulopsis n. sp. 2										
*Radix auricularia										
Stagnicola (H.) caperata										
Stagnicola (H.) montanensis										
Stagnicola (Stagnicola) elodes										
Valvata humeralis			x	x						
Vorticifex effusus dalli										
Vorticifex effusus diagonalis										
Vorticifex effusus effusus										
Vorticifex k. klamathensis		x								
Vorticifex k. sinitsini										

new
need to find on map
new
?

TABLE 3. UPPER KLAMATH SITE FAUNAL LISTS: GASTROPODS (cont.).

TAXON NAME	NUMBER OF OCCURRENCES
Ferrissia rivularis	2
Fluminicola n. sp. 1	22
Fluminicola n. sp. 2	1
Fluminicola n. sp. 3	1
Fluminicola n. sp. 7	16
Fluminicola n. sp. 8	11
Fluminicola n. sp. 9	15
Fluminicola n. sp. 16	1
Fluminicola n. sp. 27	60
Fluminicola n. sp. 28	4
Fluminicola n. sp. 29	2
Fluminicola n. sp. 30	1
Fluminicola n. sp. 31	10
Fluminicola n. sp. 42	18
Fossaria (B.) bulimoides	1
Fossaria (Fossaria) modicella	7
Fossaria (Fossaria) parva	0
Gyraulus (A.) crista	1
Gyraulus (T.) parvus	33
Helisoma (C.) newberryi	17
Juga (Oreobasis) "nigrina"	4
Juga (Oreobasis) nigrina	5
Lanx alta	8
Lanx klamathensis	18
Lymnaea stagnalis appressa	8
Lyogyrus n. sp. 3	8
Lyogyrus n. sp. 4	8
Lyogyrus n. sp. 5	8
Menetus (M.) callioglyptus	16
Physa (Physa) skinneri	1
Physella (Costatella) virgata	14
Physella (Physella) gyrina	61
Physella (Physella) lordi	26
Planorbella (P.) subcrenata	21
Planorbella (P.) tenuis	0
Promenetus exacuous	4
Promenetus umbilicatellus	8
**Psuedosuccinea columella*	1
Pyrgulopsis archimedis	11
Pyrgulopsis n. sp. 1	7
Pyrgulopsis n. sp. 2	13
**Radix auricularia*	24
Stagnicola (H.) caperata	29
Stagnicola (H.) montanensis	1
Stagnicola (Stagnicola) elodes	13
Valvata humeralis	32
Vorticifex effusus dalli	4
Vorticifex effusus diagonalis	5
Vorticifex effusus effusus	39
Vorticifex k. klamathensis	14
Vorticifex k. sinitsini	19

• = in BCD

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.

	TAXON NAME	SITE NUMBER										
		1	2	3	4	5	6	7	8	9	10	11
•	*Anodonta californiensis* California											
floaters	*Anodonta wahlametensis* Willamette											
	Anodonta oregonensis											
•	*Gonidea angulata* (NOT TRACK)											
•	*Margaritifera falcata* (NOT TRACK)											
	Corbicula fluminea											
	Sphaerium occidentale											
	Sphaerium patella											
	Sphaerium striatinum											
	Musculium raymondi											
	Musculium securis											
	Pisidium idahoense											
	Pisidium casertanum			x								
	Pisidium compressum											
peaclam	*Pisidium pauperculum*			x								
•	*Pisidium ultramontanum* Montane											
	Pisidium n. sp. 1 Modoc											
	Pisidium variabile											
	Pisidium insigne		x									
	Pisidium punctatum											
	SITE DIVERSITY	3	3	9	1	2	6	7	2	2	3	1

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	12	13	14	15	16	17	18	19	20	21	22
Anodonta californiensis										x	
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense										x	
Pisidium casertanum											
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum				x	x	x					
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne											
Pisidium punctatum				x							
SITE DIVERSITY	2	2	1	9	5	4	2	4	3	4	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	23	24	25	26	27	28	29	30	31	32	33
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata						x					
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi		x									
Musculium securis											
Pisidium idahoense											
Pisidium casertanum											
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne							x				
Pisidium punctatum											
SITE DIVERSITY	5	10	2	1	0	2	4	2	0	0	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	34	35	36	37	38	39	40	41	42	43	44
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum								x			
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum			x		x	x					
Pisidium compressum											
Pisidium pauperculum					x						
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile					x		x				
Pisidium insigne			x								x
Pisidium punctatum											
SITE DIVERSITY	0	0	4	3	5	4	2	2	1	1	2

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	45	46	47	48	49	50	51	52	53	54	55
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum								x			
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum			x	x				x			
Pisidium compressum											
Pisidium pauperculum			x								
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile			x	x				x			
Pisidium insigne			x					x		x	
Pisidium punctatum											
SITE DIVERSITY	3	3	8	7	3	5	2	7	2	5	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	56	57	58	59	60	61	62	63	64	65	66
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata									x		
Margaritifera falcata									x		
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi	x										
Musculium securis											
Pisidium idahoense											
Pisidium casertanum	x							x			x
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile		x								x	x
Pisidium insigne										x	
Pisidium punctatum											
SITE DIVERSITY	7	8	0	0	0	0	1	2	7	6	9

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	67	68	69	70	71	72	73	74	75	76	77
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum	x										
Musculium raymondi											
Musculium securis											
Pisidium idahoense	x										
Pisidium casertanum				x						x	
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne										x	
Pisidium punctatum											
SITE DIVERSITY	9	2	1	3	1	0	0	1	0	2	1

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER										
	78	79	80	81	82	83	84	85	86	87	88
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum			x								
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	0	2	6	2	2	0	2	0	0	0	1

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	89	90	91	92	93	94	95	96	97	98	99
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata							x				
Margaritifera falcata							x				
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum							x			x	x
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum							x		x	x	x
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1						x					
Pisidium variabile							x		x	x	x
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	1	0	0	0	1	7	11	2	6	9	7

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	100	101	102	103	104	105	106	107	108	109	110
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum				[x]							
Musculium raymondi											
Musculium securis											
Pisidium idahoense							x				
Pisidium casertanum						[x]					
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile						[x]	x				
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	2	0	0	1	0	2	7	0	0	0	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER										
	111	112	113	114	115	116	117	118	119	120	121
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis									x		
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi									x		
Musculium securis											
Pisidium idahoense											
Pisidium casertanum				[x]	[x]			x	x		
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile						x	x		x		
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	0	0	0	1	2	3	6	8	9	0	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	122	123	124	125	126	127	128	129	130	131	132
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis							x				
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella					x						
Sphaerium striatinum											
Musculium raymondi							x				
Musculium securis											
Pisidium idahoense											
Pisidium casertanum					x		x				
Pisidium compressum							x				
Pisidium pauperculum											
Pisidium ultramontanum							x				
Pisidium n. sp. 1							x				
Pisidium variabile					x		x			[x]	
Pisidium insigne											
Pisidium punctatum							x				
SITE DIVERSITY	0	0	0	1	5	4	16	4	5	1	2

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	133	134	135	136	137	138	139	140	141	142	143
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											x
Musculium securis											
Pisidium idahoense											
Pisidium casertanum	x	x		x						x	
Pisidium compressum	x										
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile	x						x				x
Pisidium insigne				x							
Pisidium punctatum											
SITE DIVERSITY	6	3	3	4	1	3	5	0	0	10	10

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	144	145	146	147	148	149	150	151	152	153	154
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella						x					
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense							x				
Pisidium casertanum	x	x	[x]			x	x	x	[x]		[x]
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile	x	x					x				
Pisidium insigne									[x]		
Pisidium punctatum											
SITE DIVERSITY	8	9	1	0	0	3	4	2	2	0	1

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	155	156	157	158	159	160	161	162	163	164	165
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense				x							
Pisidium casertanum		x		x		[x]		x	[x]	[x]	
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum			x								
Pisidium n. sp. 1											
Pisidium variabile				x		[x]			[x]	[x]	
Pisidium insigne										[x]	
Pisidium punctatum											
SITE DIVERSITY	1	2	11	9	0	2	0	2	2	3	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	166	167	168	169	170	171	172	173	174	175	176
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella	x										
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum	x		[x]	[x]							
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne	x										
Pisidium punctatum											
SITE DIVERSITY	5	0	1	1	0	0	0	0	0	0	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER										
	177	178	179	180	181	182	183	184	185	186	187
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum							x				
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile							x				
Pisidium insigne							x				
Pisidium punctatum											
SITE DIVERSITY	0	0	0	0	0	0	5	0	0	0	2

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	188	189	190	191	192	193	194	195	196	197	198
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis					x						
Pisidium idahoense		x		x		x		x	x	x	
Pisidium casertanum		x	x	x	x			x		x	x
Pisidium compressum		x	x	x	x	x			x	x	
Pisidium pauperculum											
Pisidium ultramontanum			x								
Pisidium n. sp. 1		x ?									
Pisidium variabile			x					x			
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	0	9	8	11	13	14	0	9	9	10	7

COMBINE

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	199	200	201	202	203	204	205	206	207	208	209
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum				x							
Musculium raymondi										x	
Musculium securis		x								x	
Pisidium idahoense			x		x		x	x		x	x
Pisidium casertanum	x	x		x			x	x			x
Pisidium compressum	x				x		x			x	x
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile	x						x				
Pisidium insigne											
Pisidium punctatum	x										
SITE DIVERSITY	11	12	9	7	8	4	9	8	7	12	9

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER										
	210	211	212	213	214	215	216	217	218	219	220
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale	x										
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis	x										
Pisidium idahoense	x										
Pisidium casertanum	x					x	x				
Pisidium compressum	x										
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile	x										
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	11	4	1	1	2	3	7	2	8	1	4

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	221	222	223	224	225	226	227	228	229	230	231
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis									x		
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi											
Musculium securis											
Pisidium idahoense											
Pisidium casertanum									x		
Pisidium compressum											
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	1	5	6	0	0	2	4	1	10	0	3

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER										
	232	233	234	235	236	237	238	239	240	241	242
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis						x					
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum		x	x								
Musculium raymondi	[o]										
Musculium securis											
Pisidium idahoense			x								
Pisidium casertanum			x								
Pisidium compressum	x										
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	6	2	7	3	1	1	8	0	0	0	0

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	243	244	245	246	247	248	249	250	251	252	253
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis						x					
Gonidea angulata							x				
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum							x				
Musculium raymondi		x									
Musculium securis											
Pisidium idahoense		x									
Pisidium casertanum	x					x					
Pisidium compressum						x	x	x	x		x
Pisidium pauperculum											x
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile	x					x					
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	4	2	0	0	0	13	8	5	1	4	7

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER										
	254	255	256	257	258	259	260	261	262	263	264
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella											
Sphaerium striatinum											
Musculium raymondi							x				
Musculium securis											
Pisidium idahoense	x										
Pisidium casertanum	x			[x]	x	x	x	x			x
Pisidium compressum	x										
Pisidium pauperculum							x				
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile						x	x	x			
Pisidium insigne									x		
Pisidium punctatum											
SITE DIVERSITY	7	0	0	1	2	4	11	4	1	0	3

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	265	266	267	268	269	270	271	272	273	274	275
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis										x	
Gonidea angulata											
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella		x						x	x		
Sphaerium striatinum								x	x	x	
Musculium raymondi											
Musculium securis											
Pisidium idahoense								x	x	x	
Pisidium casertanum		x			[x]	[x]			x	x	x
Pisidium compressum								x	x	x	
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile											
Pisidium insigne											
Pisidium punctatum											
SITE DIVERSITY	1	4	0	0	1	1	1	9	10	11	3

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	SITE NUMBER										
	276	277	278	279	280	281	282	283	284	285	286
Anodonta californiensis											
Anodonta wahlametensis											
Anodonta oregonensis											
Gonidea angulata			x								
Margaritifera falcata											
Corbicula fluminea											
Sphaerium occidentale											
Sphaerium patella	x										
Sphaerium striatinum	x		x								
Musculium raymondi											
Musculium securis											
Pisidium idahoense	x					x	x			x	
Pisidium casertanum	x		x	x	x					x	
Pisidium compressum	x				x						
Pisidium pauperculum											
Pisidium ultramontanum											
Pisidium n. sp. 1											
Pisidium variabile	x			x	x					x	
Pisidium insigne											x
Pisidium punctatum											
SITE DIVERSITY	13	0	8	8	8	5	3	0	3	6	1

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES.
(cont.)

TAXON NAME	SITE NUMBER									
	287	288	289	290	291	292	293	294	295	296
Anodonta californiensis										
Anodonta wahlametensis										
Anodonta oregonensis										
Gonidea angulata										
Margaritifera falcata										
Corbicula fluminea										
Sphaerium occidentale										
Sphaerium patella										
Sphaerium striatinum										
Musculium raymondi										
Musculium securis										
Pisidium idahoense		x								
Pisidium casertanum				x						
Pisidium compressum		x		x						
Pisidium pauperculum										
Pisidium ultramontanum										
Pisidium n. sp. 1										
Pisidium variabile										
Pisidium insigne										
Pisidium punctatum										
SITE DIVERSITY	0	7	1	3	0	0	0	2	3	2

TABLE 4. UPPER KLAMATH SITE FAUNAL LISTS: BIVALVES. (cont.)

TAXON NAME	NUMBER OF OCCURRENCES
Anodonta californiensis	1
Anodonta wahlametensis	0
Anodonta oregonensis	6
Gonidea angulata	4
Margaritifera falcata	3
Corbicula fluminea	0
Sphaerium occidentale	1
Sphaerium patella	7
Sphaerium striatinum	17
Musculium raymondi	8
Musculium securis	4
Pisidium idahoense	29
Pisidium casertanum	85
Pisidium compressum	29
Pisidium pauperculum	5
Pisidium ultramontanum	6
Pisidium n. sp. 1	3
Pisidium variabile	45
Pisidium insigne	16
Pisidium punctatum	3

TABLE 5. MUSEUM RECORDS FOR UPPER KLAMATH MOLLUSKS.

LOT NO./ INSTITUTION	NO. OF SPECS.	LOCALITY	COLLECTOR(S)
TAXON			
Lanx klamathensis			
UMMZ 62749	many	Upper Klamath Lake at S. boundary of reservation, Klamath Co., OR	
UMMZ 102565	5	Algoma, E. sideof North Klamath Lake, Klamath Co., OR	J. Henderson
UMMZ 102560	5	Klamath R. at Keno, OR	H. Hannibal
UMMZ 102561	14	North Klamath Lake, Klamath Co., OR	H. Hannibal
UMMZ 62751	2	E. shore of Agency Lake, Klamath Co., OR	-
UMMZ 102562	7	Klamath R. near Keno, Klamath Co., OR	S. S. Berry
UMMZ 102564	3	Klamath Lake, Klamath Co., OR	McAndrew
CAS 38286	6	Klamath Lake, Klamath Co., OR	ex F. L. Button coll.
CAS 32554	many	Klamath Lake, W. side, 1 mi. N. of mouth [of Link R.]	G. D. Hanna & J. L. Nichols, 7/29
CAS 32538	10	Klamath Lake, at outlet	G. D. Hanna & J. L. Nichols, 7/29
CAS 32537	20	Klamath Lake	E. Rixford, 1938
CAS 38271	4	Klamath Lake	C. L. Fox, 6/24
CAS 38269	1	Klamath Lake	-
CAS 38270	many	4 1/2 mi. N. of Algoma, Klamath Lake	G. D. Hanna & J. L. Nichols, 1929
CAS 38285	10	Klamath Lake	A. G. Smith, 1913
UCM 15930	1	Klamath Lake, OR	-
UCM 15930	many	Klamath Lake, OR	-
UCM 17744	1	Outlet of Klamath Lake, OR	-
UCM 17744	several	Outlet of Klamath Lake, OR	-
ANSP 80012	1	Upper Klamath Lake	E. D. Cope, 1879

TABLE 5. MUSEUM RECORDS FOR UPPER KLAMATH LAKE MOLLUSKS. (cont.)

LOT NO./ INSTITUTION	NO. OF SPECS.	LOCALITY	COLLECTOR(S)
TAXON			
Lanx klamathensis			
ANSP 113843	4	Upper Klamath Lake near head of Link River	H. Hannibal
ANSP 158749	2	Outlet of Link River, Klamath Co., OR	H. B. Baker, 1929
ANSP 158327	1	Ouxy Siding, E. side of Klamath Lake, OR	H. B. Baker, 1928
ANSP 346768	18	Barclay Springs, near Algoma, Klamath Lake, 42.21N 121.49W , OR	W. Walton, July 15, 1946
NMNH 334387	6	Upper Klamath Lake, OR	J. Henderson
NMNH 334388	8	Lake Klamath, Klamath Falls, OR	W. Westgate
NMNH 380814	8	Upper Klamath Lake, OR	J. Henderson
Lanx alta			
UMMZ 62782	1	Sprague R. opposite Ferguson Butte, Klamath Co., OR	-
UMMZ 62783	3	Klamath R. at Spencer Creek, Klamath Co., OR	-
UMMZ 102568	4	Klamath R. at Klamath Hot Springs, OR	S. S. Berry
UMMZ 243537	many	Klamath R. 1/4 mi. above junction of Shasta R.with the Klamath R. CA	
UMMZ 62781	many	Lost R. near Bonanza, Klamath Co., OR	-
CAS 32552	3	Williamson R., Collier Memorial State Park, OR	G. D. Hanna, 8/26/62
CAS 38267	many	Shasta R. near mouth, Siskiyou Co., CA	G. D. Hanna & Nicholson, 1929
CAS 38265	many	Klamath R. at Hamburg, Siskiyou Co, CA	W. F. Barbot
CAS 38268	many	Klamath R., Hornbrook, CA	ex R. Coats coll.
CAS 38262	many	Klamath R. near Oak Flat Creek	A. G. Smith, 7/6/24
CAS 38250	7	Klamath R., Siskiyou Co., CA	ex W. J. Reynolds coll.
CAS 32551	3	Klamath R., Klamathon, CA	G. A. Coleman, 11/13/24
CAS 75011	3	Klamath R., near Scott Bar	W. Keeler
UCM 17715	many	Klamath R. near Klamathon, CA	-

TABLE 5. MUSEUM RECORDS FOR UPPER KLAMATH LAKE MOLLUSKS. (cont.)

LOT NO./ INSTITUTION	NO. OF SPECS.	LOCALITY	COLLECTOR(S)
TAXON			
Lanx alta			
UCM 17728	many	Klamath R. S. of Hornbrook, near Klamathon, CA	J. Henderson
UCM 17730	5	Shasta R. 4 mi. above junction with Klamath R.	J. Henderson
UCM 21644	many	Shasta R. 1 1/2 mi. above junction with Klamath R.	J. Henderson
ANSP 21960	1	Klamath R.	W. M. Gabb
ANSP 330081	1	Klamath R.	W. M. Gabb
ANSP 76793	32	Klamath R., Klamathon, Siskyou Co., CA	R. C. McGregor
ANSP 137796	2	Klamathon, Klamath R., CA	G. A. Cole
DMNH 54539	2	Klamath River, Klamathon, CA	
DMNH 81241	4	Klamath River, CA	
DMNH 52162	2	Klamath River, CA	M. E. Porter, 1972
Juga (O.) nigrina			
UMMZ 65617	4	Shasta R. E. of Mt. Shasta, Shasta Co., CA	
UMMZ 134023	many	E. Shasta R., near Weed, Siskiyou Co., CA	H. Hannibal
UMMZ 134025	7	Spring near Klamath Falls, Klamath Co., OR	-
CAS 24132	12	Klamath Co., OR, 4 1/2 mi. N. of Algoma, Klamath Lake	G. D. Hanna & Nicholson, 1929
CAS 30193	6	Klamath Lake	-

TABLE 6. SITE OWNERSHIP.

OWNER	SITES
Crater Lake National Park (total 2)	107, 108
Winema National Forest (total 85)	16, 17, 18, 20, 21, 24, 25, 33, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 47, 50, 51, 53, 54, 55, 59, 60, 61, 62, 63, 64, 65, 67, 69, 70, 71, 74, 75, 76, 77, 78, 79, 93, 96, 101, 104, 105, 106, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 125, 126, 127, 128, 129, 146, 147, 155, 156, 157, 159, 160, 161, 172, 173, 174, 175, 176, 177, 179, 180, 276, 277, 278, 283, 284, 286, 288
Fremont National Forest (total 16)	28, 119, 120, 246, 247, 257, 258, 259, 260, 261, 262, 263, 267, 268, 270, 291
Klamath National Wildlife Refuge (total 3)	58, 189, 190
BLM (total 30)	10, 11, 12, 72, 81, 82, 83, 90, 91, 92, 133, 134, 135, 136, 137, 138, 139, 151, 152, 153, 154, 188, 239, 240, 241, 242, 243, 244, 245, 292
Bureau of Reclamation (total 2)	237, 238
State of Oregon (total 9*)	1, 2, 3, 5, 45, 46, 49, 52, 95
Klamath County (total 27)	7, 19, 97, 98, 99, 181, 193, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 208, 209, 210, 227, 228, 229, 254, 280
City of Bonanza (total 5)	80, 142, 143, 144, 145
City of Klamath Falls (total 2)	218, 222
City of Sprague River (total 1)	273
Other (total 111*)	4, 6, 8, 9, 13, 14, 15, 22, 23, 26, 27, 29, 30, 31, 32, 34, 48, 56, 57, 66, 68, 73, 84, 85, 86, 87, 88, 89, 94, 100, 102, 103, 121, 122, 123, 124, 130, 131, 132, 140, 141, 148, 149, 150, 158, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 178, 182, 183, 184, 185, 186, 187, 191, 192, 194, 207, 211, 212, 213, 214, 215, 216, 217, 219, 220, 221, 223, 224, 225, 226, 230, 231, 232, 233, 234, 235, 236, 248, 249, 250, 251, 252, 253, 255, 256, 264, 265, 266, 269, 271, 272, 274, 275, 279, 281, 282, 285, 287, 289, 290, 293

* note that some of these sites are wholly or in part highway right of ways and hence also publicly owned. In many cases, the extent of the highway right-of way was unclear. Ownership determined using Winema National Forest Road Atlas, Winema National Forest 1994 and Fremont National Forest 1987 1:126,720 maps.

TABLE 7. OCCURRENCE OF ALL ENDEMIC UPPER KLAMATH LAKE DRAINAGE MOLLUSKS.

TAXON	ENDEMIC STATUS			OCCURRENCE								
	UKL DRAINAGE	LOWER KLAMATH RIVER	PIT RIVER DRAINAGE	UPPER KLAMATH LAKE	LINK RIVER	ADJACENT LARGE SPRINGS	ADJACENT SMALL SPRINGS	NW SPRINGS	NE SPRINGS	LOST RIVER DRAINAGE	WILLIAMSON - SPRAGUE DRAINAGE	OTHER
Fluminicola n. sp. 1	o	o		o	o							
Fluminicola n. sp. 2	x					x						
Fluminicola n. sp. 3	x											x
Fluminicola n. sp. 7	x							x		x		x
Fluminicola n. sp. 8	x											
Fluminicola n. sp. 9	x								x			
Fluminicola n. sp. 16	o	o										o
Fluminicola n. sp. 27	x					x	x		x		x	
Fluminicola n. sp. 28	x							x				
Fluminicola n. sp. 29	x						x					
Fluminicola n. sp. 30	x									x		
Fluminicola n. sp. 31	x											x
Fluminicola n. sp. 42	x									x	x	
Helisoma (C.) newberryi	o		o	o		o			o			
Juga (Oreobasis) "*nigrina*"	o	o		o	o	o	o					
Lanx alta	o	o							o		o	
Lanx klamathensis	x			x	x	x						
Lyogyrus n. sp. 3	x				x						x	
Lyogyrus n. sp. 4	x			x		x						
Lyogyrus n. sp. 5	x					x		x				
Pyrgulopsis archimedis	x			x	x							
Pyrgulopsis n. sp. 1	x			x	x		x					
Pyrgulopsis n. sp. 2	x									x	x	
Vorticifex effusus dalli	x			x	x							
Vorticifex effusus diagonalis	x								x		x	
Vorticifex k. klamathensis	x			x	x	x						
Vorticifex k. sinitsini	x					x			x			
Pisidium (C.) n. sp. 1	o		o	o							o	
Pisidium (C.) ultramontanum	o	o	o	o								
TOTAL	29	5	3	10	7	9	4	3	6	4	7	4

EXPLANATION: white bars = occurrence x = strict Upper Klamath drainage endemic o = regional endemic

TABLE 8. OCCURRENCE OF 22 STRICT ENDEMIC UPPER KLAMATH LAKE DRAINAGE MOLLUSKS.

UKL DRAINAGE ENDEMICS	OCCURRENCE								
	UPPER KLAMATH LAKE	LINK RIVER	ADJACENT LARGE SPRINGS	ADJACENT SMALL SPRINGS	[illegible] SPRINGS	[illegible] SPRINGS	LOST RIVER DRAINAGE	[illegible] DRAINAGE	OTHER
Fluminicola n. sp. 2			X						
Fluminicola n. sp. 3									X
Fluminicola n. sp. 7					X		X		X
Fluminicola n. sp. 8									
Fluminicola n. sp. 9						X			
Fluminicola n. sp. 27			X	X		X		X	
Fluminicola n. sp. 28					X				
Fluminicola n. sp. 29				X					
Fluminicola n. sp. 30							X		
Fluminicola n. sp. 31									X
Fluminicola n. sp. 48							X	X	
Lanx klamathensis	X	X	X						
Lyogyrus n. sp. 3		X						X	
Lyogyrus n. sp. 4	X		X						
Lyogyrus n. sp. 5			X		X				
Pyrgulopsis archimedis	X	X							
Pyrgulopsis n. sp. 1	X	X		X					
Pyrgulopsis n. sp. 2							X	X	
Vorticifex effusus dalli	X	X							
Vorticifex effusus diagonalis						X		X	
Vorticifex k. klamathensis	X	X	X						
Vorticifex k. sinitsini			X			X			
TOTAL	6	6	7	3	3	4	4	5	3
ONLY	0	0	1	1	2	2	3	0	2
1 + 2	2		20						
1 + 2 + 3	6			16					
1 + 2 + 3 + 4	8				14				

TABLE 9. ECOLOGY OF 22 STRICT ENDEMIC UPPER KLAMATH LAKE DRAINAGE MOLLUSKS.

UKL DRAINAGE ENDEMICS	HABITAT								
	ANCIENT LAKE	ANCIENT LAKE SPRING	RIVER LAKE	RIVER LAKE SPRING	LARGE SPRING POND	SPRING SOURCE	SPRING RUN	RIVER	RIVER W/ SPRING INFLUENCE
Fluminicola n. sp. 2									
Fluminicola n. sp. 3									
Fluminicola n. sp. 7									
Fluminicola n. sp. 8									
Fluminicola n. sp. 9									
Fluminicola n. sp. 27									
Fluminicola n. sp. 28									
Fluminicola n. sp. 29									
Fluminicola n. sp. 30									
Fluminicola n. sp. 31									
Fluminicola n. sp. 42									
Lanx klamathensis									
Lyogyrus n. sp. 3									
Lyogyrus n. sp. 4									
Lyogyrus n. sp. 5									
Pyrgulopsis archimedis									
Pyrgulopsis n. sp. 1									
Pyrgulopsis n. sp. 2									
Vorticifex effusus dalli									
Vorticifex effusus diagonalis									
Vorticifex k. klamathensis									
Vorticifex k. sinitsini									
TOTAL	0	7	0	7	9	13	14	2	4

APPENDICES

APPENDIX A. SITES.

Map coordinates are from the latest available USGS 7.5' series topographic maps. Legal coordinates are given when practical; where survey is irregular, projected coordinates are given, orienting from the northwest section corner wherever possible. Some areas have not been surveyed, or the survey is sufficiently irregular as to make use of township and range difficult. Hence, UTM coordinates are also supplied, in the format favored by Crawford (1983). Road names, road numbers and land ownership were confirmed using DeLorme Mapping's Oregon Atlas and Gazetteer, Winema National Forest Road Atlas, Winema National Forest 1986 and Fremont National Forest 1987 1:126,720 maps. Site descriptions are a partial dump from Deixis MolluskDB™. Number in parentheses at the end of each entry refers to site map page number (see **APPENDIX B**).

Site entry format:	Project site number, Deixis locality number [in brackets], locality name, coordinates (UTM; legal), quadrangle (name and year), county, drainage, mountain range, valley, geographic description, elevation, depth, habitat description, locality remarks, collector remarks, date collected, and collectors.
Collector abbreviations as follows:	TF= Terrence J. Frest EJ= Edward J. Johannes JJ= James E. Johannes SW= Steve L. Welty, Dubois, WY DS= David C. Simon, Oregon State University, Corvallis, OR

1. [630] South source springs to the Wood River. Zone 10: 583,750E 4,731,980N. SW¼ SE¼ NE¼ SE¼ sec. 3, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Euwauna-Klamath River, Wood River Valley. Unnamed S. source springs to the Wood River at Jackson F. Kimball State Park campground, N. of Fort Klamath, off Sun Mountain Road (OR 232, FS 2300). Elev. 4197'. Depth 4-22'. Large cold spring pool and run; probably several springs as sources; abundant wood fragments at source; locally abundant *Rorippa*, bryophytes, *Mimulus*; uncommon small *Nostoc*; mud-sand-pumice gravel-rare cobble substrate. Very cold; slow-swift; clear; shallow-deep. Hand and dip net collections; partly sieved in field. Abundant *Fluminicola* locally (2 species); uncommon sphaeriids. Some modification at some spring sources; possibly partly dug out. 8/15/1991 TF, EJ, JJ! Recollect at southern spring sources; dip net and tray; field sieved to eliminate pumice. Good relaxation. Two species of *Fluminicola*; rare *Lyogyrus*; uncommon sphaeriids. 6/24/1994 TF, EJ! [B39]

2. [631] First unnamed spring south of Klamath State Fish Hatchery. Zone 10: 586,460E 4,722,210N. NE¼ NE¼ SE¼ SW¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Euwauna-Klamath River, Wood River Valley. First unnamed spring *ca.* 0.1 mi. S. of Klamath State Fish Hatchery on E. side of road to hatchery (above), *ca.* 0.5 rd. mi. N. off Crater Lake Highway (OR 62). Elev. 4190'. Depth 0-2". Small somewhat modified cold spring run; abundant *Rorippa* to E. of access road; less common below. Predominantly basalt cobble substrate to E. of road, with some mud and sand patches; slow; clear; moderately cold. Common small *Fluminicola* on cobbles; rare sphaeriids (not collected). Collected by hand and dip net. Flow partly diverted into hatchery; collected below diversion structure. 8/15/1991 TF, EJ, JJ! Common small *Fluminicola* on cobbles; rare sphaeriids (not collected). Dip net and tray collection. 6/23/1994 TF, EJ! [B41]

3. [632] Tecumseh Spring northeast of Agency Hill. Zone 10: 586,770E 4,721,340N. SW¼ NE¼ SW¼ NE¼ sec. 12, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Euwauna-Klamath River, Wood River Valley. Tecumseh Spring, beside (E. of) Crater Lake Highway (OR 62), 0.2 rd. mi. S. of OR 62 crossing of Crooked Creek, just S. of access road to Klamath State Fish Hatchery, just NE of Agency Hill. Elev. 4153'. Depth 1-36". Large, partly modified cold spring complex and pool; local *Rorippa*; dense *Myriophyllum* and *Ceratophyllum* beds in deeper areas, some substantial *Chara* stands; mostly mud substrate, with scattered gravel, cobbles, boulders, especially on E. side and S. end. Abundant *Fluminicola*; very common *Carinifex*; sphaeriids; *Physella*; very rare dead *Lanx*. Collected by hand and dip net. Partly dug out and diverted as water source. 8/15/1991 TF, EJ, JJ! Abundant *Fluminicola*; very common *Carinifex*; sphaeriids; *Physella*; rare *Lanx* on cobbles. Dip net and tray, hand collections; partly sieved in the field. 6/24/1994 TF, EJ! [B41]

4. [633] Wood River Springs at head of Wood River. Zone 10: 583,440E 4,732,680N. NE¼ NE¼ SW¼ NE¼ sec. 3, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Euwauna-Klamath River, Wood River Valley. Wood River Springs, source springs to the Wood River, N. of Jackson F. Kimball State Park, NE of Fort Klamath, off Sun Mountain Road (OR 232, FS 2300). Elev. 4200'. Depth 1-2". Cold springs with mostly fine gravel and sand (pumice) substrate; some large wood fragments; local dense *Rorippa*. Heavily grazed, with snails (common small *Fluminicola*) surviving only in fortuitously protected areas. Hand and dip net collections. 8/15/1991 TF, EJ, JJ! [B39]

5. [634] Crooked Creek 1. Zone 10: 586,580E 4,721,600N. SW¼ SW¼ NW¼ NE¼ sec. 12, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Euwauna-Klamath River, Wood River Valley. Crooked Creek above (E. of) Crater Lake Highway (OR 62) crossing just E. of access road to Klamath State Fish Hatchery. Elev. 4148'. Depth 1-18". Spring-fed cold creek with mixed mud, sand, pumice gravel

substrate; no macrophytes. Common large black *Fluminicola*. Hand, brush and tray collection. 8/15/1991 TF, EJ! [B41]

6. [635] Link River at USGS north gauging station. Zone 10: 599,550E 4,674,920N. NE¼ SW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co. Link River-Lake Ewauna-Klamath River. Link River on W. side at USGS N. gauging station, just N. of a power station, W. of Klamath Falls. Elev. 4098'. Depth 1-48". River with substrate ranging from pebbles to boulder-size rocks. Rapids. Abundant *Vorticifex klamathensis klamathensis*; common *Pyrgulopsis archimedis*; *Pyrgulopsis* n. sp.; uncommon *Lyogyrus*; common sphaeriids. Hand and dip net collections. 8/15/1991 TF, EJ, JJ! *Vorticifex klamathensis klamathensis*; common *Pyrgulopsis archimedis*; *Pyrgulopsis* n. sp.; uncommon *Lyogyrus*; common sphaeriids. Hand, dip net, and brush collected. 10/26/1992 TF, EJ, JJ! [B54]

7. [636] Barkley Spring below Modoc Rim. Zone 10: 597,930E 4,692,700N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Upper Klamath Lake Basin. Barkley Spring at the south end of Hagelstein County Park, west side of Algoma Road, east of US97 (The Dalles-California Highway) and Upper Klamath Lake, below Modoc Rim, ca. 13 mi. north of Klamath Falls. Elev. 4150'. Depth 1-4". Large cold spring pool with predominantly sand and fine pumice-basalt gravel; local mud in quiet areas and where channel is dug out; basalt boulders at one spring source. Rare *Lanx*; common large *Fluminicola*; *Vorticifex* locally common. Type locality of *Vorticifex klamathensis sinitsini* Baker, 1945. Hand collection. Collected in the spring run and in the pond. South spring diverted into concrete box at head of irrigation channel. 08/15/1991 TF, EJ, JJ! Common *Fluminicola*, *Vorticifex*, *Stagnicola caperata*, *Physella*; *Lanx*; uncommon *Lyogyrus*. Note: also collected off algal mats in spring box. Hand and dip net collected. 09/29/1997 TF, EJ! [B72]

8. [637] Williamson River at the Waterwheel Campground. Zone 10: 591,540E 4,708,360N. NW¼ SW¼ SW¼ NE¼ sec. 21, T35S R7E, Agency Lake 1985 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Waterwheel Campground (private) W. off US 97 (The Dalles-California Highway) bridge on the N. side of the Williamson River, opposite Williamson River Pumping Station. Elev. 4142'. Depth 1-4". River with gravel-cobble-some mud substrate; no macrophytes; very common odd lumber mill effluent-type algae and some protozoan coating on rocks. Gravel bar rapids. Common small *Lanx*; uncommon large *Fluminicola*. Hand collection. 8/15/1991 TF, EJ, JJ! [B4] 4212158

9. [638] Upper Klamath Lake north of Rattlesnake Point. Zone 10: 596,552E 4,688,792N. Projected from NW corner; SE¼ SE¼ SE¼ NW¼ SW¼ sec. 23, T37S R8E, Wocus 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Upper Klamath Lake just N. of Rattlesnake Point and W. of the intersection of Algoma Road and US 97 (The Dalles-California Highway), along W. side of S. P. R. R. grade. Elev. 4143'. Depth 1-4'. Lake with red pumice boulders and cobble substrate; local mud bottom. No macrophytes, but epiphytic algae common. One large species of *Fluminicola* abundant. Very rare *Lyogyrus*. Hand collection. 8/15/1991 TF, EJ, JJ! [B97]

10. [639] Klamath River east of John C. Boyle Power Plant. Zone 10: 577,140E 4,660,260N. SW¼ NE¼ SW¼ NW¼ sec. 13, T40S R6E, Chicken Hills 1986 quad., Klamath Co. Klamath River Klamath River on N. side just E. of the John C. Boyle Powerplant at RM 220.6, BLM lands. Elev. 3350-3360'. Depth 1-24". River with large scale rapids with boulders. Quiet pools scattered to side. Swift current and deep pools in center. In quiet areas, *Elodea*, *Potamogeton crispus*, *Ceratophyllum*. Collected ¼ mi. section of the river. *Juga* (*Oreobasis*) scattered, mostly in quiet pools near shore in shallow water: *Lanx* abundant throughout, most common in deep or more in current: become more rare offshore and in most violent rapids. *Fluminicola* uncommon, in quiet

pools. *Vorticifex effusus* and *Physella* mostly in quiet pool edges. Hand collected. 8/16/1991 TF, EJ, JJ! [B26]

11. [640] Unnamed spring south of John C. Boyle Power Plant. Zone 10: 576,440E 4,659,140N. NE¼ NE¼ NW¼ NE¼ sec. 23, T40S R6E, Chicken Hills 1986 quad., Klamath Co. Klamath River Unnamed spring 0.8 rd. mi. S. of John C. Boyle Power Plant on W. side of the gravel road and Klamath River (RM 219.5), BLM lands. Elev. 3400'. Depth 0-0.5". Road side cold spring. Rock face and adjacent rock and mud spring run. Very shallow; almost a trickle. No macrophytes. *Juga* mostly juveniles, collected by hand. 8/16/1991 TF, EJ, JJ! [B26]

12. [641] Unnamed spring at Klamath River RM 212.5. Zone 10: 571,700E 4,652,820N. NE¼ SE¼ SW¼ SE¼ sec. 5, T41S R6E, Mule Hill 1985 quad., Klamath Co. Klamath River Unnamed spring run on Klamath Rim above heavily grazed flat (former fen), N. of Klamath River (RM 212.5), BLM lands. Elev. 3450'. Depth 0-0.5". Small cold spring with gravel-cobble substrate, sparse sand and mud. No macrophytes. *Juga* uncommon; very small *Fluminicola* moderately common. Collected by hand. 8/16/1991 TF, EJ, JJ! [B74]

13. [642] Unnamed spring at Klamath River RM 210.8. Zone 10: 569,590E 4,652,080N. Projected from NE corner; NW¼ NW¼ SE¼ SE¼ NW¼ sec. 7, T41S R6E, Mule Hill 1985 quad., Klamath Co. Klamath River Unnamed spring run on NW side of dirt road below Klamath Rim, N. of Klamath River (RM 210.8). Elev. 3220'. Depth 1-6". Cold spring run in heavily grazed area. No macrophytes. Mud bottom with some cobbles-boulders. *Juga* (*Oreobasis*) moderately abundant, mix of juveniles and adults; hand collected. *Physella* sp. rare; not collected. 8/8/1991 TF, EJ, JJ! [B74]

14. [643] Unnamed double spring run at Klamath River RM 209.7. Zone 10: 567,920E 4,651,160N. SW¼ NE¼ SW¼ SW¼ SE¼ sec. 12, T41S R6E, Mule Hill 1985 quad., Klamath Co. Klamath River Unnamed double spring run below and to E. of power (Pacific Power and Light) substation below Klamath Rim, N. side of Klamath River at RM 209.7. Elev. 2860'. Depth 1-6". Two narrow (< 18") spring runs which have cobbles and boulder and some mud. *Scirpus* on sides. *Juga* fairly abundant, mostly adults and subadults (normal population distribution). Hand collected. Heavily grazed area. 8/16/1991 TF, EJ, JJ! [B75]

15. [799] Upper Klamath Lake at Rattlesnake Point. Zone 10: 596,456E 4,688,648N. Projected from NW corner; NE¼ SW¼ SW¼ SE¼ SW¼ sec. 23, T37S R8E, Wocus 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Upper Klamath Lake at Rattlesnake Point just SW of the intersection of Algoma Road and US 97 (The Dalles-California Highway), W. of S. P. R. R. levee. Elev. 4143'. Depth 2-4'. Lake with mud bottom with scattered basalt boulders; rare bedrock (red pumice, basalt) exposures. Mollusks hand collected. 8/15/1991 TF, EJ, JJ! Common *Pyrgulopsis archimedis*; *Pisidium ultramontanum* rare; mostly dead *Carinifex*; uncommon *Vorticifex klamathensis klamathensis*; rare *Lyogyrus*; uncommon *Fluminicola*. Collected by hand and dip net. 10/26/1992 TF, EJ, JJ! [B97]

16. [800] Unnamed springs near Ouxy Spring. Zone 10: 596,888E 4,694,528N. Quarter sections not practical; sec. 1, T37S R8E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed springs near Ouxy Spring below US 97 (The Dalles-California Highway) at rd. mi. 260.8 and S. P. R. R. track on the E. shore of the Upper Klamath Lake below Modoc Rim, Winema National Forest. Elev. 4143'. Depth 0-1". Shallow cold spring run with gravel bottom scattered red basalt with pumice like texture. Hand, brush, and dip net collection. Common *Lyogyrus*, *Fluminicola*; rare *Pyrgulopsis archimedis*; rare *Pisidium ultramontanum*. Collected at unusually low water stage of lake. 10/26/1992 TF, EJ, JJ! [B72]

17. [801] Upper Klamath Lake offshore of Ouxy Spring. Zone 10: 596,886E 4,694,528N. Quarter sections not practical; sec. 1, T37S R8E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Offshore of Ouxy Spring below S. P. R. R. track and US 97 (The Dalles-California) at rd. mi. 260.8 on the E. shore of the Upper Klamath Lake below Modoc Rim, Winema National Forest. Elev. 4143'. Depth 1-3'. Spring influenced lake with red basalt [pumice- like texture] gravel- scattered cobble substrate. No macrophytes; local epiphytic algae. Common *Lyogyrus*, *Fluminicola*; *Pyrgulopsis archimedis*; abundant *Pisidium ultramontanum*. Collected at unusually low water stage of lake. Hand, brush, and dip net collection. 10/26/1992 TF, EJ, JJ! [B72]

18. [803] Sucker Spring below Modoc Rim. Zone 10: 597,300E 4,693,750N. Quarter sections not practical; sec. 1, T37S R8E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sucker Spring below S. P. R. R. track and US 97 (The Dalles-California Highway) at about rd. mi. 261.3, on the E. side of Upper Klamath Lake below Modoc Rim, Winema National Forest. Elev. 4143'. Depth 0-2". Cold spring with well-rounded boulder-cobble substrate with local dense *Rorippa*. *Juga* (*Oreobasis*) abundant; full ontogeny. Rare *Physella*. Brush and tray, hand collections. Collected at unusually low lake water levels. 10/26/1992 TF, EJ, JJ! [B72]

19. [804] Howard Bay boat ramp on the west side of Upper Klamath Lake. Zone 10: 587,260E 4,684,920N. SW¼ NW¼ NW¼ NE¼ sec. 36, T37S R7E, Howard Bay 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Howard Bay boat ramp on the on W. side of Upper Klamath Lake at Howard Bay just off OR 140 (Lake of the Woods Highway). Elev. 4143'. Depth 1-4'. Lake with predominantly mud substrate and scattered basalt cobbles, boulders; rip-rap near shore. Dense macrophytes off shore but none close (*Ceratophyllum*, *Nelumbo*). Rather warm and turbid; nil velocity. No live mollusks except *Physella*; dead *Stagnicola*, *Planorbella* (not collected). 10/27/1992 TF, EJ, JJ! [B52]

20. [805] Camporee Spring at Odessa Campground. Zone 10: 577,270E 4,697,800N. NW¼ NW¼ NW¼ NE¼ sec. 24, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Odessa Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Camporee Spring along Odessa Creek at Odessa Campground off OR 140 (Lake of the Woods Highway) on FS 3639, Upper Klamath Lake, Winema National Forest. Elev. 4143'. Depth 1-5". Spring with basal boulders, cobbles, and pebbles. Vesicular basalt or pumice pebbles are present. No macrophytes; common epiphytic algae (*Cladophora*). Only adult *Fluminicola* were found in spring; most abundant at mouth. Spring collected at extreme low-water level in Upper Klamath Lake; usually underwater at normal water levels. Hand, tray, and brush collections. 10/27/1992 TF, EJ, JJ! [B79]

21. [806] Odessa Creek at Camporee Spring. Zone 10: 577,270E 4,697,800N. NW¼ NW¼ NW¼ NE¼ sec. 24, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Odessa Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Odessa Creek on both sides of Camporee Spring in Odessa Campground off OR 140 (Lake of the Woods Highway) on FS 3639, Upper Klamath Lake, Winema National Forest. Elev. 4143'. Depth 1-5'. Creek with sparse cobbles (except near spring); mostly mud-gravel substrate, including fossil fish bones. *Elodea* 8-9' from shore. Dredged creek channel on either side of the nearby Camporee Spring. Dip net, trawl, and hand collections. Common *Carinifex*, *Pisidium idahoense*; *Fluminicola*; uncommon *Lanx* and *Lyogyrus* on rocks. Rare *Anodonta californiensis*? 10/27/1992 TF, EJ, JJ! [B79]

22. [807] Unnamed spring west of Odessa and Camporee Springs. Zone 10: 576,100E 4,697,450N. NW¼ NW¼ SE¼ NE¼ sec. 23, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring W. of Odessa and Camporee Springs on the west side of OR 140 (Lake of the Woods Highway), Winema National

Forest. Elev. 4154'. Boulder-cobble substrate. Spring now dry. No mollusks. 10/27/1992 TF, EJ, JJ! 10/27/1992 TF, EJ, JJ! [B79]

23. [808] Harriman Spring in Harriman Spring Resort. Zone 10: 574,060E 4,701,960N. SW¼ SW¼ SW¼ NE¼ sec. 3, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Harriman Spring in Harriman Spring Resort at Harriman Lodge, off Westside Road on W. side of Upper Klamath Lake. Elev. 4143'. Depth 2-38". Composite cold spring channel with red basalt cobble-boulder bottom draining directly into Upper Klamath Lake. Rare *Rorippa* near shore. Offshore *Veronica* and very abundant huge *Nostoc pruniforme* accumulations. Both spring sources and offshore runs were collected. Lake levels unusually low. Collected by hand, dip net, brush and tray. Common *Fluminicola* (possibly two spp.); common *Lyogyrus* on *Nostoc* undersides and rocks; common *Vorticifex* and uncommon *Lanx* on rocks. 10/27/1992 TF, EJ, JJ! [B78]

24. [809] Malone Spring east side of FS 3459. Zone 10: 575,180E 4,708,850N. SW¼ SW¼ NE¼ NW¼ sec. 14, T35S R6E, Crystal Spring 1985 quad., Klamath Co. Crystal Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Malone Spring *ca.* 0.9 rd. mi. off (E. of) Westside Road along FS 3459 near Malone Springs Picnic Area and boat ramp, tributary of Crystal Creek, W. of Agency Lake, Winema National Forest. Elev. 4143'. Depth 0-4'. Cold spring with mud with occasional cobbles. Macrophytes present. Hand and dip net collections. Rare *Carinifex*, *Lanx*; uncommon *Fluminicola*, *Lyogyrus*, *Lymnaea stagnalis appressa*, sphaeriids. 10/27/1992 TF, EJ, JJ! Recollected at normal lake level; trawl, dip net and tray collections. Fauna as above; but more common *Carinifex*, *Fluminicola*, *Lymnaea*. 6/23/1994 TF, EJ! [B32]

25. [810] Mares Egg Spring at head of Crane Creek. Zone 10: 576,850E 4,723,300N. Quarter sections not practical; sec. 2, T34S R6E, Mares Egg Spring 1985 quad., Klamath Co. Crane Creek-Fourmile Creek-Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Mares Egg Spring at head of Crane Creek on E. side of Westside Road, Winema National Forest. Elev. 4147'. Depth 0-13". Very cold spring runs and large pool with *Rorippa* and *Mimulus* mostly confined to edges; *Nostoc* accumulations in deeper pool. Substrate predominantly sand, silt, mud; some highly calcareous. Clear; deep in center. Common downed trees, wood. Rare *Vorticifex*; common small *Fluminicola* in small side springs on N. end; rare sphaeriids in main pool. Dip net and hand collections. Spring level has dropped due to illegal dredging of Crane Creek by a farmer. 10/27/1992 TF, EJ, JJ! Revisited after some repair of 1992 damage; water level higher; *Nostoc* not improved. Not collected. [B67]

26. [839] Klamath River at RM 214.9. Zone 10: 574,400E 4,652,610N. SE¼ SE¼ NE¼ SE¼ SW¼ sec. 3, T41S R6E, Chicken Hills 1986 quad., Klamath Co. Klamath River. West side of the Klamath River SE of Grizzly Butte below Klamath Rim at RM 214.9. Elev. 3160'. Depth 1-2'. River with boulder substrate. Polluted. *Lanx* rare. Hand collected. River polluted. 8/16/1991 TF, EJ, JJ! [B27]

27. [1115] Penny Spring at site of Penny Guard Station. Zone 10: 574,550E 4,663,040N. NW¼ NE¼ SW¼ NW¼ SE¼ sec. 3, T40S R6E, Chicken Hills 1986 quad., Klamath Co. Unnamed Creek-Klamath River. Penny Spring at the site of Penny Spring Guard Station just off OR 66 (Green Springs Highway) (N. side), E. of Hayden Mountain Summit. Elev. 4550'. Mud-sand-cobble substrate; no epiphytic algae or macrophytes. Almost dry spring; most water diverted for water at source at now-abandoned guard station. No mollusks. 8/16/1991 TF, EJ, JJ! [B26]

28. [1753] South Fork Sprague River at Forest Service picnic ground. Zone 10: 667,330E 4,693,020N. SW¼ NW¼ SW¼ NW¼ SE¼ sec. 8, T37S R15E, Paradise Mountain 1988 quad., Klamath Co. S. Fk. Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. South Fork Sprague River at Sprague River Picnic Area, off

and N. of OR 140 (Klamath Falls-Lakeview Highway) about 0.7 rd. mi., Fremont National Forest. Elev. 4400'. Depth 2-12". Partly impounded small river; sand-cobble substrate; small riffle-pools; scattered macrophytes (*Myriophyllum*, *Potamogeton filiformis*); common *Cladophora*. Rare *Margaritifera falcata*, *Physella*; hand and dip net collections. Somewhat eutropified. 6/20/1994 TF, EJ! [B76]

29. [1761] Unnamed spring near Beatty Gap. Zone 10: 644,240E 4,700,500N. NW¼ NW¼ NW¼ SE¼ SW¼ sec. 13, T36S R12E, Ferguson Mountain 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Large unnamed spring in pasture, originating just W. of (below) OR 140 (Klamath Falls-Lakeview Highway), 1.5 mi. E. of Beatty, W. of Beatty Gap. Elev. 4320'. Depth 2-9". Large cold spring with mostly sand and mud substrate, with local basalt cobbles; no macrophytes; scattered *Mimulus*; some small *Rivularia* colonies. Common small *Fluminicola*, rare *Vorticifex*, very rare dead *Pyrgulopsis*. Dip net and tray collections. Area heavily grazed. 6/21/1994 TF, EJ! [B37]

30. [1762] Brown Spring east of Oregon Pines Road. Zone 10: 639,190E 4,706,410N. SE¼ NW¼ NE¼ NW¼ NW¼ sec. 33, T35S R12E, Beatty 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Brown Spring to the E. of Oregon Pines Road. Elev. 4320'. Depth 2-6". Eutrophic large cold spring pond with abundant filamentous algae, *Myriophyllum*; common *Elodea*; *Potamogeton crispus*; *Ceratophyllum*; mud-fine gravel substrate. Uncommon medium-sized *Fluminicola* and sphaeriids; rare *Vorticifex* on algae; common *Physella*. Spring heavily grazed; partly dug out and diverted into irrigation system. 6/21/1994 TF, EJ! Dip net collection. Very rare *Fluminicola* and sphaeriids. 10/22/1995 TF, EJ! [B15]

31. [1763] Calohan Spring on north side of Bly Mountain Pass. Zone 10: 632,000E 4,690,580N. SE¼ NW¼ NW¼ SW¼ SE¼ sec. 15, T37S R12E, Yonna 1988 quad., Klamath Co. Upper Klamath Lake-Link River-Klamath River. Calohan Spring on N. side of Bly Mountain Pass 0.3 mi. and just W. of OR 140 (Klamath Falls-Lakeview Highway). Elev. 5040'. Dry spring. No mollusks. 6/21/1994 TF, EJ! [B99]

32. [1764] Wildhorse Spring on south side of Bly Mountain Pass. Zone 10: 631,810E 4,689,290N. Center NE¼ NE¼ SW¼ sec. 22, T37S R12E, Yonna 1988 quad., Klamath Co. Klamath Lake-Link River-Lake Ewauna-Klamath River. Wildhorse Spring on S. side of Bly Mountain Pass 0.6 mi. and just W. of OR 140 (Klamath Falls-Lakeview), Wildhorse Canyon. Elev. 4960'. Dry spring. No mollusks. 6/21/1994 TF, EJ! [B99]

33. [1777] Rock Creek 1. Zone 10: 574,280E 4,711,500N. NE¼ NE¼ NE¼ NW ¼ SE¼ sec. 3, T35S R6E, Crystal Spring 1985 quad., Klamath Co. Rock Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Rock Creek 0.5 mi. W. of Westside Road on FS 3419, W. of Agency Lake, Winema National Forest. Elev. 4260'. Depth 1-5". Small very cold creek with cobble substrate; *Rivularia*, small *Nostoc*; no macrophytes; no caddis flies; slow, clear current. No mollusks, creek possibly dries (rarely?); dip net and hand collections attempted. 6/22/1994 TF, EJ! [B32]

34. [1778] Rock Creek 2. Zone 10: 575,100E 4,711,810N. W½ SW¼ NW¼ SE ¼ NW¼ sec. 2, T35S R6E, Crystal Spring 1985 quad., Klamath Co. Rock Creek-Crystal Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Distributary channel of Rock Creek on W. side of Westside Road, *ca.* 0.3-0.5 mi. N. of FS 3419 turnoff, W. of Agency Lake. Elev. 4165'. Dry creek. No mollusks, dry creek. 6/22/1994 TF, EJ! [B32]

35. [1779] Cherry Creek south of Tiger Lily Spring. Zone 10: 574,740E 4,717,230N. Center SE¼ SW¼ SW ¼ SW¼ sec. 14, T34S R6E, Crystal Spring 1985 quad., Klamath Co. Cherry Creek-

Fourmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath, Wood River Valley. Cherry Creek channel along (W. of) Westside Road, about 0.45 mi. S. of Tiger Lily Spring, NW of Agency Lake, Winema National Forest. Elev. 4238'. Dry creek. No mollusks, dry creek. 6/22/1994 TF, EJ! [B33]

36. [1780] Unnamed spring south of Tiger Lily Spring. Zone 10: 574,450E 4,718,330N. Center NW¼ NE¼ SE ¼ NE¼ sec. 15, T34S R6E, Crystal Spring 1985 quad., Klamath Co. Cherry Creek-Fourmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath, Wood River Valley. Small spring 0.1 mi. S. of Tiger Lily Spring E. of (just below) Westside Road, Winema National Forest. Elev. 4200'. Depth 2-4". Cold spring with predominantly mud (uncommon gravel and cobbles); common wood fragments. No macrophytes; in open meadow with *Spiranthes*, *Mimulus*, *Allium* spp., *Aconitum*, *Saxifraga*. Common small *Fluminicola*, rare *Promenetus*, sphaeriids; dip net and tray collections. Snails absent at source, present near E. fence line. Channeled and diverted to Cherry Creek; impacted by grazing. 6/22/1994 TF, EJ! [B33]

37. [1781] Tiger Lily Spring east of Westside Road. Zone 10: 574,470E 4,718,430N. SE¼ NW¼ NE¼ SE ¼ NE¼ sec. 15, T34S R6E, Crystal Spring 1985 quad., Klamath Co. Cherry Creek-Fourmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath, Wood River Valley. Tiger Lily Spring just E. of (below) Westside Road and 0.3 mi. S. of mouth of Nannie Creek, NW of Agency Lake, Winema National Forest. Elev. 3990'. Depth 2-6". Three cold spring channels with abundant *Mimulus*, *Saxifraga*; rarer *Spiranthes* (wet rich open meadow); mud-cobble substrate; no macrophytes; some epiphytic algae. Uncommon *Fluminicola*; abundant or absent locally depending on grazing; dip net and tray collections. Mostly diverted to irrigation ditch; heavily grazed; 3 separate spring channels over 0.1 mi.; 1 without snails. 6/22/1994 TF, EJ! [B33]

38. [1782] Jack Spring east of Westside Road. Zone 10: 575,320E 4,719,890N. SE¼ SE¼ NE¼ SE ¼ NW¼ sec. 11, T34S R6E, Mares Egg Spring 1985 quad., Klamath Co. Fourmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Jack Spring *ca.* 0.45 mi. S. of Fourmile Spring just E. of Westside Road, Winema National Forest. Elev. 4160'. Depth 1-6". Small narrow cold spring channels (two) in *Pinus ponderosa* forest and partly open meadow. No macrophytes; common *Mimulus*, *Aconitum*, *Allium* spp., tiger lily; less common *Spiranthes*, *Salix*, Prunus, *Cornus stolonifera*; common *Pyrola* spp.; abundant wood fragments; mud substrate with uncommon cobbles. *Fluminicola* uncommon; dip net and tray collections. Impacted by grazing, fire. 6/22/1994 TF, EJ! [B68]

39. [1783] Fourmile Spring at head of Fourmile Creek. Zone 10: 575,790E 4,720,340N. SE¼ NE¼ NE¼ NW ¼ NE¼ sec. 11, T34S R6E, Mares Egg Spring 1985 quad., Klamath Co. Fourmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Fourmile Spring at head of Fourmile Creek, E. of Westside Road, *ca.* 0.75 mi. S. of mouth of Threemile Creek, Winema National Forest. Elev. 4158'. Depth 12-38". Large deep (dug out) cold spring pool tributary to strongly agriculturally impacted creek; W. end open, deep; *Nostoc*, rare algae and moss, common wood fragments; mud substrate; rest soupy mud, abundant epiphytic algae (*Cladophora*), *Ceratophyllum*. *Fluminicola* and *Vorticifex* rare, very rare *Menetus* and sphaeriids; dip net collections. Mostly dug out and deepened; *Fluminicola* and *Vorticifex* only in extreme W. end. Mollusks very rare elsewhere (*Menetus*, sphaeriids). 6/22/1994 TF, EJ! [B68]

40. [1784] Unnamed spring channels east of FS 3300. Zone 10: 575,090E 4,724,240N. SE¼ SE¼ SE¼ SE ¼ NW¼ sec. 35, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Crane Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring channels (3) E. of FS 3300 0.15 mi. N. of junction with Sevenmile Road, headwater of Crane Creek, Winema National Forest. Elev. 4170'. Depth 0-3". Three small cold

spring channels in a very wet *Pinus ponderosa* forest and closed sedge-grass meadow, abundant wood fragments; no macrophytes. *Fluminicola* very rare and local, uncommon sphaeriids; dip net and hand collections. Several small and shallow spring runs, some with high gradient. 6/22/1994 TF, EJ! [B67]

41. [1785] First unnamed spring north of FS 3300. Zone 10: 575,100E 4,724,200N. SE¼ SE¼ SE¼ SE ¼ NW¼ sec. 35, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Crane Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring pool E. of FS 3300 0.15 mi. N. of junction with Sevenmile Road, headwater of Crane Creek, Winema National Forest. Elev. 4160'. Depth 0-36". Cold spring pool with mud substrate and patchy gravel; abundant wood fragments; no macrophytes. Snails (*Menetus*, sphaeriids) rare; hand (off wood fragments) and dip net collections. 6/22/1994 TF, EJ! [B67]

42. [1786] Short Creek unnamed springs-south end. Zone 10: 575,360E 4,725,400N. SE¼ SW¼ SE¼ NW¼ SE¼ sec. 26, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Spring runs at S. end of Short Creek pool, *ca.* 0.92 rd. mi. N. on FS 3300 from Sevenmile Road junction, Winema National Forest. Elev. 4160'. Depth 0-4". Several small-medium sized steep and shallow cold spring runs (S. part of large spring complex); mud-cobble (red vesicular basalt) substrate; abundant *Mimulus, Allium, Aconitum*, bryophytes, etc. (rich cool open meadow); no macrophytes. Swift clear current. Uncommon *Fluminicola*; hand, dip net and tray collections. Near fence line and impacted by grazing; spring partly diverted into irrigation canal. 6/22/1994 TF, EJ! [B67]

43. [1787] Short Creek unnamed springs-middle. Zone 10: 575,390E 4,725,450N. NE¼ SW¼ SE¼ NW¼ SE¼ sec. 26, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Spring runs near middle of Short Creek pool, *ca.* 0.98 rd. mi. N. on FS 3300 from Sevenmile Road junction, Winema National Forest. Elev. 4160'. Depth 2-6". Several small-medium sized steep and shallow cold spring runs (middle part of large spring complex); mud-cobble (red vesicular basalt) substrate; abundant *Mimulus, Allium, Aconitum, Pyrola*, bryophytes, etc. (rich cool open meadow); no macrophytes. Swift clear current. Common small *Fluminicola*. Hand, dip net and tray collections. Some grazing impact; springs partly diverted into irrigation canal. 6/22/1994 TF, EJ! [B67]

44. [1788] Short Creek unnamed springs-north end. Zone 10: 575,400E 4,725,520N. NE¼ NW¼ NE¼ SW¼ SE¼ sec. 26, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Spring runs on N. end of Short Creek pool, *ca.* 1.0 rd. mi. N. on FS 3300 from Sevenmile Road junction, Winema National Forest. Elev. 4160'. Depth 2-6". Several small-medium sized steep and shallow cold spring runs (N. part of large spring complex); mud-cobble (red vesicular basalt) substrate; abundant *Mimulus, Allium, Aconitum, Pyrola*, bryophytes, etc. (rich cool open meadow); no macrophytes. Swift clear current. Common small *Fluminicola*, Vespericola; hand, dip net, and tray collections. Minor grazing impact; springs partly diverted into irrigation canal. 6/22/1994 TF, EJ! [B67]

45. [1789] North source springs of Klamath State Fish Hatchery. Zone 10: 586,380E 4,722,500N. SW¼ SE¼ NE¼ NE¼ SW¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed springs at N. end of Klamath State Fish Hatchery, *ca.* 0.7 rd. mi. on access road from Crater Lake Highway (OR 62); concrete pool against rock rim; 3 major spring runs at upper end; and channel from catchment pool. Elev. 4200'. Depth 1-28". Cold springs and pool

flows. Small *Fluminicola* abundant (2 species)-small at source, large lower down; uncommon *Vorticifex* on solid surfaces in pool and channel; hand, dip net, and tray collections; most collected from cobbles. Concrete pool was drained for modifications. 6/23/1994 TF, EJ! [B41]

46. [1790] Klamath State Fish Hatchery-2nd channel. Zone 10: 586,340E 4,722,500N. NE¼ NW¼ SE¼ NE¼ SW¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Second spring channel from N. source springs of Klamath State Fish Hatchery, *ca.* 0.7 mi. on access road from Crater Lake Highway (OR 62). Elev. 4160'. Depth 4-18". Large cold spring run from multiple sources; mud, sand and rare cobbles area; sizable *Myriophyllum* beds; rare *Mimulus*. Clear swift current. Abundant small-sized *Fluminicola*; rarer *Vorticifex*; very rare dark mantled *Lyogyrus*; snails abundant on *Myriophyllum*; dip net and tray collections. Large multiple spring sources; run diverted into fish hatchery. 6/23/1994 TF, EJ! [B41]

47. [1792] Unnamed spring at head of Crooked Creek. Zone 10: 584,900E 4,726,320N. NW¼ NE¼ NW¼ SW¼ NE¼ sec. 26, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Large unnamed spring and run at base of Sugar Hill E. of Fort Creek, ultimate source of Crooked Creek, *ca.* 0.5 mi. SE of site of Fort Klamath, N. of Thompson Road terminus, Winema National Forest. Elev. 4160'. Depth 4-24". Large, partly dug out, cold spring; mud-pumice cobble substrate; common wood debris; scattered *Myriophyllum*; common *Mimulus* at sides of run; deep pool at head. Abundant small *Fluminicola*; rarer *Vorticifex*; common sphaeriids. Hand and dip net collections. Grazed despite fencing; somewhat modified. 6/23/1994 TF, EJ! [B40]

48. [1793] Agency Spring east of Klamath Agency. Zone 10: 587,770E 4,718,920N. NE¼ SE¼ NE¼ SW¼ SW¼ sec. 18, T34S R7E, Agency Lake 1985 quad., Klamath Co. Agency Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Agency Spring just E. of OR 62 (Crater Lake Highway) and Klamath Agency. Elev. 4180'. Depth 4-36". Large, dug-out, cold spring pool; mostly mud with scattered red basalt cobbles; scattered *Myriophyllum*; abundant wood fragments. Clear slow flow. Abundant medium-sized tall *Fluminicola*; common *Vorticifex* and sphaeriids; uncommon *Stagnicola*. Dip net and hand collections. Dug out and dammed (former small power plant to the W.). 6/23/1994 TF, EJ! [B5]

49. [1794] Second unnamed spring south of Klamath Fish Hatchery. Zone 10: 586,470E 4,722,100N. SE¼ SE¼ NE¼ SE¼ SW¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring run *ca.* 0.15 mi. S. of Klamath State Fish Hatchery and W. of access road (below), 0.15 rd. mi. from Crater Lake Highway (OR 62). Elev. 4170'. Depth 1-6". Several cold spring runs on vegetated talus and combined channel below; *Spiranthes*, bryophytes, *Cystopteris*; mud-cobble (basalt) substrate with some pumice; talus open with wet meadow vegetation; *Mimulus*, common *Myriophyllum*. Clear slow flow. Not shown on USGS map. Abundant *Fluminicola* (2 spp.?); uncommon *Vorticifex*. Hand, dip net, and tray collections. Partly diverted to hatchery at head. 6/24/1994 TF, EJ! [B41]

50. [1795] Third unnamed spring south of Klamath Fish Hatchery. Zone 10: 586,540E 4,721,960N. Center SW¼ SW¼ SW¼ SE¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring run *ca.* 0.25 mi. S. of Klamath Hatchery and W. of access road (below), *ca.* 0.35 rd. mi. N. of Crater Lake Highway (OR 62), Winema National Forest. Elev. 4180'. Depth 2-10". Small cold spring runs on vegetated talus (open and wet meadow) and combined run below; abundant *Mimulus*, scattered *Myriophyllum* and rare *Rorippa*; sand-basalt cobble substrate with fine pumice. Not shown on USGS map. Abundant *Fluminicola* (2 spp.?);

uncommon *Vorticifex*. Hand, dip net, and tray collections. Partly diverted at source to hatchery. 6/24/1994 TF, EJ! [B41]

51. [1796] Fourth unnamed spring south of Klamath Fish Hatchery. Zone 10: 586,560E 4,721,920N. SE¼ SW¼ SW¼ SW¼ SE¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring run *ca.* 0.30 mi. S. of Klamath Hatchery and W. of access road (below), *ca.* 0.30 rd. mi. N. of Crater Lake Highway (OR 62), Winema National Forest. Elev. 4180'. Depth 1-11". Several small cold spring runs on open basalt talus with wet meadow vegetation and combined run below; abundant *Mimulus*; rare *Myriophyllum*; basalt cobbles-mud. Not shown on USGS map. Abundant *Fluminicola* (2 spp.); uncommon *Vorticifex*. Hand, dip net, and tray collections. Partly diverted at source to hatchery. 6/24/1994 TF, EJ! [B41]

52. [1797] Crooked Creek 2. Zone 10: 586,440E 4,722,060N. NE¼ NW¼ SE¼ NE¼ SW¼ sec. 1, T34S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Crooked Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Crooked Creek collected *ca.* 0.20 mi. S. of Klamath Fish Hatchery, below (W. of) access road, E. of Crater Lake Highway (OR 62). Elev. 4155'. Depth 6-21". Large slow spring-fed cold creek; dominantly mud substrate; *Scirpus*, sedges, some *Myriophyllum*. Near locality 1794. Abundant medium-sized *Fluminicola*; *Menetus*. Dip net collections. Agricultural impact. 6/24/1994 TF, EJ! [B41]

53. [1798] Fort Creek below Reservation Spring. Zone 10: 584,780E 4,727,700N. Projected from NW corner; SW¼ NW¼ SW¼ SW¼ NE¼ sec. 23, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Fort Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Fort Creek collected 0.3 mi. from source (Reservation Spring), *ca.* 0.7 mi. NE of Fort Klamath (site), 1.5 mi. E. of Fort Klamath, off (E. of) Sun Mountain Road (OR 232, FS 2300), Winema National Forest. Elev. 4180'. Depth 4-18". Large cold spring-fed creek with pumice cobbles and sand; no macrophytes; common *Cladophora*; some wood fragments. *Fluminicola* (small) and *Vorticifex* rare (more common at source, locality 1799); dip net and tray collections. Grazed badly; impounded below (*ca.* 0.3 mi. S.). Dam presently breached but may be repaired. 6/24/1994 TF, EJ! [B40]

54. [1799] Reservation Spring northeast of Fort Klamath. Zone 10: 585,080E 4,728,100N. Projected from NW corner; NW¼ NE¼ SE¼ NW¼ NE¼ sec. 23, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Fort Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Reservation Spring, ultimate source of Fort Creek, *ca.* 1.0 mi. NE of Fort Klamath (site), 1.7 mi. E. of Fort Klamath, off (E. of) Sun Mountain Road (OR 232, FS 2300), Winema National Forest. Elev. 4180'. Depth 4-18". Large and very cold spring at source with pumice cobble-sand substrate; no macrophytes; common *Mimulus* at edges; in *Pinus ponderosa* forest; swift flow. Abundant *Fluminicola* (2 spp.); uncommon *Vorticifex*. Dip net and tray collections. Relatively pristine; grazed elsewhere. 6/24/1994 TF, EJ! [B40]

55. [1851] Wood River at Wood River Picnic Ground. Zone 10: 582,600E 4,728,750N. NW¼ SE¼ SE¼ NW¼ SW¼ sec. 15, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co. Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Wood River Picnic Ground on Wood River at about RM 15, *ca.* 0.45 mi. NNE of Fort Klamath, 0.70 rd. mi. off (W. of) Sun Mountain Road (OR 232, FS 2300), Winema National Forest. Elev. 4180'. Depth 2-43". River with sand, gravel, and cobbles substrate; deep pools; no macrophytes; rare *Myriophyllum*. No mollusks; dip net collections attempted. Unstable substrate? 6/24/1994 TF, EJ! [B39]

56. [1852] Odessa Spring at Odessa Ranch. Zone 10: 576,840E 4,697,600N. NE¼ SW¼ SW¼ NE¼ NW¼ sec. 24, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Odessa Creek-Upper

Klamath Lake-Link River-Lake Ewauna-Klamath River. Odessa Spring at Odessa Ranch (Wampler), *ca.* 0.55 mi. E. of OR 140 (Lake of The Woods Highway). Elev. 4147'. Depth 4-36". Eutrophic and modified large spring pond and run; source of Odessa Creek; trashed; abundant filamentous algae, *Ceratophyllum*, *Elodea*; predominant mud substrate. *Planorbella*, common sphaeriids, *Radix*, *Physella*, rare *Valvata*; dip net and tray collections. Agriculture impacted. 6/25/1994 TF, EJ! [B79]

57. [1853] Odessa Creek east of Odessa Spring. Zone 10: 577,040E 4,697,610N. NW¼ NW¼ SE¼ NE¼ NW¼ sec. 24, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Odessa Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Odessa Creek *ca.* 0.13 mi. E. of Odessa Spring, below the mouth of unnamed spring, Odessa Ranch (Wampler). Elev. 4147'. Depth 4-40". Large spring-fed creek; local *Myriophyllum*, *Potamogeton crispus*, *Elodea*, *Ceratophyllum*; some filamentous algae; mud-cobble substrate. Abundant *Fluminicola*; common *Vorticifex*, uncommon *Lanx klamathensis*; hand, dip net and tray collections. 6/25/1994 TF, EJ! [B79]

58. [1854] Channel in Klamath Marsh along Silver Lake Road. Zone 10: 608,200E 4,749,870N. SW¼ NE¼ NW¼ SE¼ SW¼ sec. 8, T31S R9E, Military Crossing 1988 quad., Klamath Co. Klamath Marsh-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Dug-out channel on Silver Lake Road (Klamath County 676), S. end of Klamath Marsh, Klamath National Wildlife Refuge. Elev. 4510'. Depth 1-40". Deep channel paralleling road; "dark water", in peat; muddy-organic substrate; common *Nelumbo, Ceratophyllum.* No mollusks; dip net collection attempted. Dug-out channel, in peat. 6/26/1994 TF, EJ! [B71]

59. [1855] Wocus Butte Spring west of Wocus Bay. Zone 10: 609,235E 4,741,940N. SE¼ SE¼ SW¼ NE¼ SE¼ sec. 5, T32S R9E, Wocus Bay 1988 quad., Klamath Co. Klamath Marsh-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Wocus Butte Spring on E. side of Wocus Butte, W. of FS 4357 and Wocus Bay, Klamath Marsh, Winema National Forest. Elev. 3850'. Depth 0-1". Almost dry small cold spring with pumice substrate. No mollusks. 6/26/1994 TF, EJ! [B98]

60. [1856] Recovery Spring along Klamath County 43. Zone 10: 608,970E 4,739,100N. SE¼ SW¼ SE¼ SW¼ NE¼ sec. 17, T32S R9E, Wocus Bay 1988 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Recovery Spring along Klamath County 43, above Millhayes Meadow, Winema National Forest. Elev. 4640'. Dry small spring; pumice substrate. No mollusks. Dry spring. 6/26/1994 TF, EJ! [B98]

61. [1857] Hog Creek at Klamath County 43 crossing. Zone 10: 601,550E 4,736,120N. NW¼ NW¼ NW¼ SW¼ NW¼ sec. 27, T32S R8E, Fuego 1988 quad., Klamath Co. Hog Creek-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hog Creek at Klamath County 43 crossing, Winema National Forest. Elev. 4620'. Depth 0-4". Cold creek with muddy substrate; no macrophytes. No mollusks; dip net collection attempted. Almost dry. 6/26/1994 TF, EJ! [B43]

62. [1858] Williamson River Campground-north spring. Zone 10: 594,340E 4,723,360N. Projected from SW corner; SE¼ SW¼ NE¼ NE¼ NW¼ sec. 2, T34S R7E, Soloman Butte 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed small spring on W. side of Williamson River toward N. end of Williamson River Campground off (E. of) FS 9730, Winema National Forest. Elev. 4195'. Depth 0-3". Small cold spring with abundant *Rorippa*; cobble-mud substrate; several small runs. Not shown on USGS map. Common small *Fluminicola*; hand, dip net and tray collections. Somewhat impacted by human traffic. 6/26/1994 TF, EJ! [B85]

63. [1859] Williamson River Campground-south spring. Zone 10: 594,335E 4,723,360N. Projected from SW corner; NE¼ NW¼ SE¼ NE¼ NW¼ sec. 2, T34S R7E, Soloman Butte 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed small spring on W. side of Williamson River, flowing out from below (E. of) well with hand pump in Williamson River Campground off (E. of) FS 9730, Winema National Forest. Elev. 4195'. Depth 0-2". Very small cold spring with cobble-mud substrate; *Rorippa* covered. Fe staining on substrate. Not on USGS map. Sparse small *Fluminicola*; hand and dip net collections. Partly piped at source. 6/26/1994 TF, EJ! [B85]

64. [1860] Williamson River at Williamson River Campground. Zone 10: 594,360E 4,723,400N. Projected from SW corner; E½ NW¼ SE¼ NE¼ NW¼ sec. 2, T34S R7E, Soloman Butte 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Williamson River on E. side of Williamson River Campground off (E. of) FS 9730, Winema National Forest. Elev. 4195'. Depth 2-34". Cold river with predominantly basalt cobble; riffles to deep pools; spring-influenced; abundant *Myriophyllum* locally; common *Elodea* (2 spp.) locally, some filamentous algae; bryophytes, *Potamogeton* filifomis uncommon. Abundant *Fluminicola*, common *Vorticifex*, *Lanx*, *Margaritifera falcata*, *Gonidea angulata*; rarer sphaeriids, *Physella*. Hand, dip net, and tray collections. Exceptional mollusk habitat. 6/26/1994 TF, EJ! Recollected 10/08/97 TF, EJ! As above; *Lyogyrus* also found on cobbles in quiet areas. [B85]

65. [1861] Unnamed spring at head of Spring Creek. Zone 10: 591,310E 4,724,450N. NW¼ SW¼ SW¼ SW¼ NE¼ sec. 33, T33S R7E, Fort Klamath 1985 quad., Klamath Co. Spring Creek-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring at head of Spring Creek, S. of Spring Creek Campground at the end of FS 9732, W. of US 97, N. of Collier Memorial State Park, Winema National Forest. Elev. 4190'. Depth 2-15". Large cold partly artesian spring; basalt bedrock, pumice sand/gravel and scattered gravel substrate; common *Rorippa*, white *Liparis*. Common small *Fluminicola*, uncommon *Vorticifex*; dip net and tray collections. Relatively pristine large spring. 6/26/1994 TF, EJ! [B42]

66. [1867] Crystal Spring at head of Crystal Creek. Zone 10: 575,420E 4,713,800N. SE¼ SE¼ NE¼ NE¼ NW¼ sec. 35, T34S R6E, Crystal Spring 1985 quad., Klamath Co. Crystal Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Crystal Spring at head of Crystal Creek 0.25 mi. E. of Westside Road at site of Crystal. Elev. 4145'. Depth 4-36". Diffuse cold spring, deep pool (dug out) at origin of Crystal Creek; dense macrophytes (*Ceratophyllum*, *Elodea*) and dense epiphytic algae offshore; mud-red basalt cobble substrate; common wood. Common *Carinifex* and *Vorticifex*; uncommon *Lyogyrus* and small *Fluminicola*. Dip net and tray collections. Mostly dug out; snails out only near W. shore. 6/27/1994 TF, EJ! [B33]

67. [1868] Recreation Creek at Rocky Point Resort boat launch. Zone 10: 575,120E 4,703,020N. SW¼ NE¼ NE¼ SW¼ SW¼ sec. 35, T35S R6E, Pelican Bay 1985 quad., Klamath Co. Recreation Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. N. side of boat launch at Rocky Point Resort on Recreation Creek, Winema National Forest. Elev. 4150'. Depth 12-60". Large cold creek channel with dense macrophytes (*Ceratophyllum*, local *Myriophyllum*, common *Elodea*, common *Potamogeton crispus*); mud-gravel and cobble (red basalt) substrate. Spring influenced through the gravel bottom locally, anoxic mud elsewhere. Abundant *Carinifex*, common *Vorticifex*, *Pisidium idahoensis*; rare *Fluminicola*. Trawl, dip net and tray collections. 6/28/1994 TF, EJ! [B78]

68. [1869] Second unnamed spring north on FS 3300. Zone 10: 575,280E 4,724,680N. NE¼ SE¼ SW¼ NW¼ NE¼ sec. 35, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Crane Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring to E. of FS 3300, *ca.* 0.4 mi. N. of junction with Sevenmile Road, N.-most headwater of Crane Creek. Elev. 4160'. Depth 0-14". Cold spring with mud substrate; thick

Elodea in pool. *Fluminicola* (moderate sized) moderately abundant in pool; rare elsewhere. Dip net and tray collections. Heavily grazed; partly dug out and channelized. 6/28/1994 TF, EJ! [B67]

69. [1870] Third unnamed spring north on FS 3300. Zone 10: 575,380E 4,725,900N. NE¼ SW¼ SE¼ SW¼ NE¼ sec. 26, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring to E. of FS 3300, *ca.* 1.25 mi. N. of junction with Sevenmile Road, Winema National Forest. Elev. 4180'. Depth 0-6". Several anastamosing moderately steep very cold spring runs; slow-moderate clear flow; open meadow with white orchids, *Aconitum*, sedges, abundant *Mimulus*, bryophytes. *Fluminicola* uncommon, sporadically distributed; hand, dip net and tray. Relatively intact spring. 6/28/1994 TF, EJ! [B67]

70. [1871] Fourth unnamed spring north on FS 3300. Zone 10: 575,650E 4,726,500N. NE¼ SE¼ NW¼ SE¼ NE¼ sec. 26, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring lake on Short Creek, *ca.* 1.65 mi. N. on FS 3300 from junction with Sevenmile Road and E. of FS 3300, inholding in Winema National Forest. Elev. 4175'. Depth 12-36". Deep cold pool; dug-out springs; pumice gravel and mud substrate with abundant wood, no macrophytes. *Fluminicola* very rare, in comparatively deep water. Mostly destroyed (dug out). 6/28/1994 TF, EJ! [B67]

71. [1872] Source spring to Short Creek. Zone 10: 575,680E 4,727,720N. NW¼ SW¼ NE¼ SE¼ NE¼ sec. 26, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Source spring of Short Creek, E. of FS 3300 and S. 0.4 mi. from junction with Sevenmile Road, Winema National Forest. Elev. 4190'. Depth 4-12". Cold spring with pumice gravel and mud; common wood and conifer needles; common bryophytes. Common medium-sized *Fluminicola*; dip net and tray collections. Relatively intact; modified at source. 6/28/1994 TF, EJ! [B67]

72. [1873] Spencer Creek above Spencer Creek Hook-Up Road crossing. Zone 10: 574,440E 4,674,920N. SW¼ SE¼ SW¼ NW¼ NE¼ sec. 34, T38S R6E, Spencer Creek 1986 quad., Klamath Co. Spencer Creek-Klamath River. Spencer Creek above crossing of Spencer Creek Hook-Up Road, *ca.* 1.6 mi. W. of Clover Creek Road, BLM lands. Elev. 4090'. Depth 2-8". Large cold creek; cobble-gravel substrate; no macrophytes; common brown algae. No mollusks; dip net and hand collections attempted. Agricultural and grazing impact. 6/29/1994 TF, EJ! [B87]

73. [1874] Unnamed spring on Clover Creek Road. Zone 10: 566,065E 4,681,670N. SW¼ SE¼ SE¼ SE¼ SW¼ sec. 2, T38S R5E, Lake of the Woods South 1985 quad., Klamath Co. Buck Valley-Spencer Creek-Klamath River. Small unnamed spring above (W. of) Clover Creek Road and 0.7 mi. E. of locality 1875, inholding in Winema National Forest. Elev. 4980'. Depth 0-1". Cold clear spring with *Mimulus*; sedge meadow above and below road. Sphaeriids only, not retained. Collected by hand and dip net. Area grazed severely. 6/29/1994 TF, EJ! [B59]

74. [1875] Unnamed spring off FS 950. Zone 10: 565,285E 4,681,900N. NW¼ NE¼ SE¼ SE¼ SE¼ sec. 3, T38S R5E, Lake of the Woods South 1985 quad., Klamath Co. Buck Valley-Spencer Creek-Klamath River. Unnamed spring just W. of FS 950 0.1 mi. and N. of Clover Creek Road, Winema National Forest. Elev. 4980'. Depth 1-6". Small cold spring run in a mostly dry creek bed in extensive boggy sedge meadow; cobble-mud substrate; no macrophytes; common bryophytes; *Aconitum*, *Saxifraga*, *Dodecatheon*, blazing star, *Spiranthes*, cranberry, *Allium* spp. in meadow. Common *Fluminicola*; hand, dip net and tray collections. Meadow grazed. 6/29/1994 TF, EJ! [B59]

75. [1876] Crystalline Spring west of FS 3790. Zone 10: 565,060E 4,684,340N. NW¼ NE¼ SW¼ SE¼ NE¼ sec. 34, T37S R5E, Lake of the Woods South 1985 quad., Klamath Co. Unnamed Creek-Buck Lake-Spencer Creek-Klamath River. Crystalline Spring below (W. of) FS 3790, *ca.* 1.8 mi. E. from Dead Indian Memorial Road, Winema National Forest. Elev. 5260'. Depth 0-2". Small cold spring in wet sedge meadow; *Salix*, *Saxifraga*, *Spiranthes*, *Allium* spp., etc.; mud substrate. Not on USGS map. Sphaeriids only, not retained. Hand, dip net collections. Badly grazed; damaged by selective logging. 6/29/1994 TF, EJ! [B59]

76. [1877] Rainbow Springs at head of Rainbow Creek. Zone 10: 565,680E 4,685,800N. NE¼ SE¼ SE¼ SW¼ NW¼ sec. 26, T37S R5E, Lake of the Woods South 1985 quad., Klamath Co. Rainbow Creek-Lake Of The Woods-Seldom Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Rainbow Springs at head of Rainbow Creek, to E. 0.1 mi. from FS 3750, S. of Lake of the Woods, Winema National Forest. Elev. 5115'. Depth 1-6". Several small anastamosing cold spring runs in wet sedge meadow; primarily mud bottom with occasional basalt cobbles; *Mimulus*, common bryophytes in runs; *Saxifraga*, bryophytes, *Aconitum*, *Spiranthes*, *Dodecatheon*, blazing star, etc. Common small *Fluminicola*; dip net and tray collections. Grazed, but meadow in good condition. 6/29/1994 TF, EJ! [B60]

77. [1878] Unnamed Rainbow Creek spring. Zone 10: 564,880E 4,686,820N. SE¼ NE¼ NE¼ SW¼ SE¼ sec. 22, T37S R5E, Lake of the Woods South 1985 quad., Klamath Co. Rainbow Creek-Lake Of The Woods-Seldom Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring S. of (below) FS 3750 to E. of unnamed tributary to Rainbow Creek, S. of Lake of the Woods, Winema National Forest. Elev. 5050'. Depth 0-2". Cold spring with mud-fine gravel substrate; very short run; no macrophytes; rare bryophytes; in wet sedge meadow with *Spiranthes*, *Aconitum*, *Saxifraga*, etc. Not on USGS map. Sphaeriids only, not retained; dip net and hand collections. 6/29/1994 TF, EJ! [B60]

78. [1879] Rainbow Creek at FS 3750 crossing. Zone 10: 564,630E 4,687,220N. SE¼ NE¼ NE¼ SW¼ SE¼ sec. 22, T37S R5E, Lake of the Woods South 1985 quad., Klamath Co. Rainbow Creek-Lake Of The Woods-Seldom Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Rainbow Creek at crossing of FS 3750, *ca.* 0.5 mi. SW from Dead Indian Memorial Road, S. of Lake of the Woods, Winema National Forest. Elev. 5020'. Depth 2-6". Small cold creek (spring-fed above); cobble substrate; no macrophytes; common brown algae and wood fragments; small *Nostoc*. No mollusks; hand and dip net collections. 6/29/1994 TF, EJ! [B60]

79. [1880] Cold Creek south of Lake of the Woods. Zone 10: 565,320E 4,688,000N. NE¼ SE¼ NE¼ NE¼ NE¼ 22 & NW¼ SW¼ NW¼ NW¼ NW¼ sec. 23, T37S R5E, Lake of the Woods South 1985 quad., Klamath Co. Cold Creek-Lake Of The Woods-Seldom Creek-Fourmile Creek-U. Klamath Lake-Link River-Lake Ewauna-Klamath River. Cold Creek on both sides of Dead Indian Memorial Road, S. end of Lake of the Woods, Winema National Forest. Elev. 4970'. Depth 0-2". Very small cold creek; mud-gravel substrate with abundant conifer needles and wood; no macrophytes; uncommon bryophytes. Clear slow current. Very rare *Fluminicola* and sphaeriids; hand and dip net collections. Relatively pristine except to E. 6/29/1994 TF, EJ! [B60]

80. [1881] Big Springs at Bonanza. Zone 10: 632,150E 4,672,820N. SE¼ NW¼ NE¼ SE¼ SW¼ sec. 10, T39S R11E, Bonanza 1988 quad., Klamath Co. Lost River-Lower Klamath Lake, Yonna Valley. Big Springs on E. side of Bonanza in Big Springs City Park, S. of East Langell Valley Road, W. side of Lost River. Elev. 4118'. Depth 2-21". Two large cold springs with mostly mud substrate with some basalt cobbles; very abundant and large *Rorippa* to W.; to E. *Lemna*, filamentous algae, *Potamogeton crispus*, *Potamogeton filiformis*, *Elodea*. Abundant *Fluminicola* (2 spp?), *Pyrgulopsis*; unusual small *Vorticifex* sp., less common *Physella*, *Helisoma*; hand, dip net and tray collections. Partly diverted for city water supply (at source); collected when it was partly

impounded by backflooding from Lost River. 6/30/1994 TF, EJ!. *Fluminicola* n. sp. (2 spp.), *Pyrgulopsis*, small *Vorticifex* sp. hand, dip net and tray collections. 10/26/1995 TF, EJ [B18]

81. [1882] Ben Hall Spring east of Ben Hall Creek. Zone 10: 652,690E 4,676,130N. SE¼ SE¼ SE¼ SW¼ SW¼ sec. 35, T38S R13E, Goodlow Mountain 1988 quad., Klamath Co. Ben Hall Creek-Miller Creek-Lost River-Lower Klamath Lake. Ben Hall Spring on NW side of Gerber Reservoir, E. side of Ben Hall Creek, W. of Gerber Road, BLM lands. Elev. 4845'. Depth 18". Former spring converted to cow trough; no free flow. *Stagnicola*, *Physella* dip net collections. Snails from trough. Spring totally piped to trough. 6/30/1994 TF, EJ! [B48]

82. [1883] Ben Hall Creek west of Gerber Road. Zone 10: 652,640E 4,676,160N. SE¼ SW¼ SE¼ SW¼ SW¼ sec. 35, T38S R13E, Goodlow Mountain 1988 quad., Klamath Co. Ben Hall Creek-Miller Creek-Lost River-Lower Klamath Lake. Ben Hall Creek on NW arm of Gerber Reservoir and 0.1 mi. NW of Ben Hall Spring off (W. of) Gerber Road, BLM lands. Elev. 4840'. Depth 0-6". Creek with mud and gravel; common epiphytic algae; *Potamogeton filiformis*; *Ceratophyllum*; channel dry above site. Common *Stagnicola* and *Physella*; dip net collections. Trenched and occasionally flooded by reservoir. 6/30/1994 TF, EJ! [B48]

83. [1884] Stan H. Spring northwest of Gerber Reservoir. Zone 10: 653,640E 4,676,840N. NW¼ SE¼ NW¼ NE¼ SE¼ sec. 35, T38S R13E, Goodlow Mountain 1988 quad., Klamath Co. Ben Hall Creek-Miller Creek-Lost River-Lower Klamath Lake. Stan H. Spring in BLM campground, NW edge of Gerber Reservoir. Elev. 4860'. Dry spring. Sign indicates this spring is named Stan H. Spring despite USGS 7.5' map. Piped by BLM; spring dry even in trough. 6/30/1994 TF, EJ! [B48]

84. [1885] Barnes Creek spring 1. Zone 10: 657,340E 4,678,300N. SW¼ NW¼ SE¼ NW¼ SW¼ sec. 29, T38S R14E, Gerber Reservoir 1988 quad., Klamath Co. Barnes Creek-Miller Creek-Lost River-Lower Klamath Lake. Unnamed spring 0.3 mi. E. Barnes Creek, N. side of Gerber Dam Road (FS 3814), N. end of Gerber Reservoir. Elev. 4860'. Depth 1-28". Large cold clear spring run; mud substrate; dense *Rorippa*, *Lemna*, in boggy pasture. *Physella* and *Radix* only, dip net collected; not retained. Heavily pastured; boggy. 6/30/1994 TF, EJ! [B45]

85. [1886] Barnes Creek spring 2. Zone 10: 657,420E 4,678,260N. NE¼ SW¼ SE¼ NW¼ SW¼ sec. 29, T38S R14E, Gerber Reservoir 1988 quad., Klamath Co. Barnes Creek-Miller Creek-Lost River-Lower Klamath Lake. Unnamed spring 0.35 mi. E. of Barnes Creek, N. side of Gerber Dam Road (FS 3814), N. end of Gerber Reservoir. Elev. 4860'. Depth 1-28". Dry spring. No mollusks, dry spring. 6/30/1994 TF, EJ! [B45]

86. [1887] Barnes Creek spring 3. Zone 10: 657,665E 4,678,180N. NW¼ NE¼ NW¼ SE¼ SW¼ sec. 29, T38S R14E, Gerber Reservoir 1988 quad., Klamath Co. Barnes Creek-Miller Creek-Lost River-Lower Klamath Lake. Unnamed spring 0.5 mi. E. of Barnes Creek, N. side of Gerber Dam Road (FS 3814), N. end of Gerber Reservoir. Elev. 4850'. Dry spring. No mollusks. 6/30/1994 TF, EJ! [B45]

87. [1888] J Spring run east side of Gerber Dam Road. Zone 10: 658,735E 4,676,875N. NW¼ SE¼ NE¼ NE¼ SE¼ sec. 32, T38S R14E, Gerber Reservoir 1988 quad., Klamath Co. Miller Creek-Lost River-Lower Klamath Lake. Large spring run of J Spring, *ca.* 1.6 mi. SE of Barnes Creek on E. side of Gerber Dam Road (FS 3814), E. side of Gerber Reservoir. Elev. 4960'. Dry spring run. No mollusks. 6/30/1994 TF, EJ! [B45]

88. [1889] Casebeer Spring on north side of Gerber Dam Road. Zone 10: 660,220E 4,674,430N. NW¼ NE¼ SW¼ NE¼ NE¼ sec. 9, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co. Miller Creek-Lost River-Lower Klamath Lake. Casebeer Spring run on E. side of Gerber Reservoir, N. side of Gerber Dam Road (FS 3814). Elev. 4960'. Depth 0-2". Shallow large cold spring run; mud,

gravel and basalt cobbles; scattered *Mimulus* and *Rorippa*. Common medium-sized *Fluminicola* and rare *Physella*; hand collection. Heavily grazed. 6/30/1994 TF, EJ! [B46]

89. [1890] First spring south of Casebeer Spring. Zone 10: 660,490E 4,674,050N. SE¼ SE¼ NE¼ SE¼ NE¼ sec. 9, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co. Miller Creek-Lost River-Lower Klamath Lake. First unnamed spring 0.3 mi. S. of Casebeer Spring run, E. side of Gerber Dam Road (FS 3814) and Gerber Reservoir. Elev. 5040'. Dry spring, all diverted to field irrigation. No mollusks. 6/30/1994 TF, EJ! [B46]

90. [1891] Second spring south of Casebeer Spring. Zone 10: 660,500E 4,673,970N. SE¼ NE¼ SE¼ SE¼ NE¼ sec. 9, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co. Miller Creek-Lost River-Lower Klamath Lake. Second unnamed spring 0.4 mi. S. of Casebeer Spring run, E. side of Gerber Dam Road and Gerber Reservoir, BLM lands. Elev. 5040'. Dry spring, all diverted to field irrigation. No mollusks. 6/30/1994 TF, EJ! [B46]

91. [1892] Third to fifth springs south of Casebeer Spring. Zone 10: 660,520E 4,673,740N. E½ NE¼ NE¼ NE¼ SE¼ sec. 9, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co. Miller Creek-Lost River-Lower Klamath Lake. Third to fifth unnamed springs 0.5 mi. S. of Casebeer Spring run, E. side of Gerber Dam Road (FS 3814) and Gerber Reservoir, BLM lands. Elev. 5030'. Three dry small springs, all diverted to field irrigation. No mollusks. 6/30/1994 TF, EJ! [B46]

92. [1893] Sixth spring south of Casebeer Spring. Zone 10: 660,540E 4,673,600N. NW¼ NW¼ SW¼ NW¼ SW¼ sec. 10, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co. Miller Creek-Lost River-Lower Klamath Lake. Sixth unnamed springs 0.7 mi. S. of Casebeer Spring run, E. side of Gerber Dam Road (FS 3814) and Gerber Reservoir, BLM lands. Elev. 5000'. Dry spring, all diverted to field irrigation. No mollusks. 6/30/1994 TF, EJ! [B46]

93. [1894] Crystal Castle Spring northeast of Chiloquin Ridge Road. Zone 10: 597,245E 4,711,020N. SE¼ SE¼ NW¼ SW¼ SW¼ sec. 7, T35S R8E, Chiloquin 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Crystal Castle Spring on NE side of Chiloquin Ridge Road (FS 5810), Winema National Forest. Elev. 4600'. Depth 0-2". Cold spring with common *Mimulus*; some wet meadow plants, e.g. *Aconitum, Spiranthes*; narrow channel; mud-gravel substrate. Small *Menetus*; dip net collection. Badly grazed, mostly piped. 7/1/1994 TF, EJ! [B29]

94. [1895] Sprague River upstream of Chiloquin Ridge Road bridge. Zone 10: 595,095E 4,715,120N. NW¼ NW¼ SE¼ NE¼ NE¼ sec. 35, T34S R7E, Chiloquin 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. S. side of Sprague River upstream of Chiloquin Ridge Road (FS 5810) bridge at fisherman's access, E. of Chiloquin. Elev. 4220'. Depth 6-20". Cold river with abundant macrophytes (*Potamogeton crispus*, *Potamogeton filiformis*; *Elodea*; *Myriophyllum*; *Ceratophyllum*; sponges; some filamentous algae; silt, mud and sand pocket on dominantly cobble substrate; medium-sized shallow river with partly cemented substrate. Rare *Valvata*; uncommon *Lyogyrus*; uncommon *Vorticifex*; uncommon *Fluminicola*; common *Margaritifera falcata, Gonidea angulata*. Hand and dip net collections. Somewhat eutropified; snails abundant. 7/1/1994 TF, EJ! [B29]

95. [1896] Spring Creek at Collier Memorial State Park Picnic Area. Zone 10: 591,680E 4,722,180N. E½ SW¼ NE¼ SE¼ SW¼ sec. 4, T34S R7E, Fort Klamath 1985 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Spring Creek collected on W. side, near picnic and day use area N. of museum, Collier Memorial State Park, W. of US 97. Elev. 4190'. Depth 6-48". Large deep spring channel; silt and mud, some cobble and basalt bedrock; rare macrophytes (*Myriophyllum*); abundant wood. Abundant large *Lanx* and

Vorticifex; uncommon *Fluminicola*, rare *Physella* and *Menetus*. Hand and dip net collections. 7/1/1994 TF, EJ! [B42]

96. [2152] Ouxy Spring on east side of Upper Klamath Lake. Zone 10: 596,940E 4,694,540N. Quarter sections not practical; sec. 1, T37S R8E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Ouxy Spring source (source on east side of BN-SPRR track) and run under and west of BN-SPRR. track, west of US97 at rd. mi. 260.8, ca. 0.9 mi. NW of Hagelstein County Park, east side of Upper Klamath Lake, at base of Modoc Rim. Elev. 4150'. Depth 0-2". Small shallow cold spring run; mostly sandy, with basalt cobbles locally; no macrophytes or epiphytic algae. Abundant *Juga* (*Oreobasis*), mostly immature; common *Fluminicola*. Hand collection. Suckers spawning at mouth (Lost River, Shortnose); chubs spawning at head of spring run. 04/26/1995 TF, EJ, SW! Abundant *Juga* (*Oreobasis*) and common *Fluminicola*. Hand collection. 10/10/1997 TF, EJ! [B72]

97. [1697] Barkley Spring-middle cove. Zone 10: 597,860E 4,692,760N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Small cove in center of N-S. channel in Hagelstein County Park, midway between N. and S. source springs, W. of Algoma Road near the junction with US 97 (The Dalles-California Highway), E. side of Upper Klamath Lake below Modoc Rim, *ca.* 13 mi. N. of Klamath Falls. Elev. 4150'. Depth 1-52". Large limnocrene pool in small cove; mostly mud and gravel substrate; abundant *Potamogeton crispus*, some *Potamogeton filiformis*; *Ceratophyllum*, *Elodea*; abundant epiphytic algae; common deciduous leaves. Mostly open shoreline. Dip net and tray collections. Common *Fluminicola*, uncommon *Stagnicola*, *Physella*, *Valvata*, and sphaeriids. No spawning gravel. 4/27/1995 TF, EJ! [B72]

98. [1698] Barkley Spring-opposite north source spring. Zone 10: 597,820E 4,692,820N. Quarter sections not practical; sec. 6, T37S RE, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Cold spring run, W. side, opposite N. source spring, N. end of Hagelstein County Park, between Algoma Road and US 97 (The Dalles-California Highway), E. side of Upper Klamath Lake below Modoc Rim, 13 mi. N. of Klamath Falls. Elev. 4150'. Depth 0-48". Large cold spring run; mixed mud, gravel, rare cobble substrate; abundant epiphytic algae; common *Ceratophyllum*, *Elodea*, some *Lemna trisulca*; effectively a limnocrene. Spawning gravel placed sometime in 1994. Dip net and tray collections. Abundant *Fluminicola*; common sphaeriids; uncommon *Carinifex*, *Vorticifex*; rare *Lyogyrus*, *Physella*. 4/27/1995 TF, EJ! [B72]

99. [1699] Barkley Spring-north source spring. Zone 10: 597,820E 4,692,880N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Large cold spring at N. end of Hagelstein County Park, between Algoma Road and US 97 (The Dalles-California Highway), E. side of Upper Klamath Lake below Modoc Rim, *ca.* 13 mi. N. of Klamath Falls. Elev. 4150'. Depth 2-60". Large basalt boulders with mud patches; abundant wood and plant fragments; abundant *Ceratophyllum*; *Elodea*; epiphytic algae uncommon; large cold spring and adjacent run, effectively a limnocrene. Spawning gravel placed nearby sometime in 1994. Dip net and tray collections. Uncommon *Carinifex*; large sphaeriids; uncommon *Lanx* and *Vorticifex* on rocks; common *Fluminicola*. 4/27/1995 TF, EJ! [B72]

100. [1791] Klamath River below Keno Dam. Zone 10: 586,980E 4,664,360N. NE¼ SE¼ NE¼ SW¼ SW¼ sec. 36, T39S R7E, Keno 1985 quad., Klamath Co. Klamath River. Klamath River on N. side below Keno Dam at RM 232.8, W. of Keno. Elev. 4020'. Depth 4-16". River with boulders and patches of mud-silt. Patches of *Ceratophyllum*. *Vorticifex effusus effusus* and *Physella* hand collected. Looks like treated sewage in river. 8/16/1991 TF, EJ, JJ! [B53]

101. [1862] Cold Spring at Cold Spring Campground. Zone 10: 576,330E 4,710,235N. Unsurveyed area; no coordinates possible., Pelican Butte 1985 quad., Klamath Co. Lost Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Cold Spring at Cold Spring Campground at end of FS 3651, Winema National Forest. Elev. 5845'. Depth 0-2". Cold spring with cobble bottom; no macrophytes. No mollusks. Wooden fence around spring; altered for water supply for campground. 6/27/1994 TF, EJ! [B80]

102. [1863] Unnamed spring west of Dairy. Zone 10: 621,810E 4,676,595N. SE¼ SE¼ NW¼ SW¼ NW¼ sec. 34, T38S R11 ½E, Dairy 1985 quad., Klamath Co. Alkali Lake-Buck Creek-Lost River-Lower Klamath Lake, Yonna Valley. Unnamed spring 0.3 mi. W. of Dairy on N. side of OR 140 (Klamath Falls-Lakeview Highway). Elev. 4135'. Former cold spring now dry. No mollusks. Spring piped and dry. 6/21/1994 TF, EJ! [B34]

103. [1864] Campbell Spring west of East Langell Valley Road. Zone 10: 645,860E 4,666,220N. NE¼ NE¼ NW¼ NE¼ NE¼ sec. 1, T40S R13E, Goodlow Mountain 1988 quad., Klamath Co. Lost River-Lower Klamath Lake. Campbell Spring run 0.2 mi. WSW of intersection of East Langell Valley Road and Gerber Reservoir Road, at former site of Haynesville. Elev. 4160'. Depth 4-12". Large cold spring run; abundant *Rorippa*; sand, gravel, and cobble substrate. Sphaeriids only; dip net collected. Modified; in fenced farmyard. 6/30/1994 TF, EJ! [B49]

104. [1865] Lost Creek west of Cold Creek Road. Zone 10: 566,260E 4,705,100N. Unsurveyed; T35S R5E, Lake of the Woods North 1985 quad., Klamath Co. Lost Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Yonna Valley. Lost Creek, 0.5 mi. W. of Cold Creek Road (FS 3651) and 1.0 mi. N. of Lost Creek cinder pit, Winema National Forest. Cold creek with predominantly cobble substrate; local epiphytic algae; no macrophytes. No mollusks. Dip net and hand collections attempted. 6/27/1994 TF, EJ! [B56]

105. [1866] Unnamed springs west of Lost Creek. Zone 10: 566,250E 4,705,040N. Unsurveyed; T35S R5E, Lake of the Woods North 1985 quad., Klamath Co. Lost Creek-Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring runs (3) to W. of Cold Creek Road (FS 3651), *ca.* 0.7 mi. NW of Lost Creek cinder pit, W. of Lost Creek, Winema National Forest. Depth 0-2". Open sedge meadow in Ponderosa pine forest; *Pyrola, Aconitum, Vaccinum, Viola, Leparis, Spiranthes*; 3 small spring runs; cobble-mud substrate; abundant bryophytes; local *Rorippa* and *Mimulus*. Dip net and hand collections; sphaeriids only, not retained. 6/27/1994 TF, EJ! [B56]

106. [2142] Williamson River northeast of gravel pit. Zone 10: 595,460E 4,724,920N. NW¼ SW¼ SE¼ NW¼ NW¼ sec. 36, T33S R7E, Soloman Butte 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. W. side of Williamson River, *ca.* 0.5 mi. NE of gravel pit at terminus of FS 9730-200, Winema National Forest. Elev. 4210'. Depth 2-28". Medium-sized river with braided channel. Areas collected with muddy substrate (more typically rocky); open, grassy meadow with nearby basalt cliffs. River high-almost flood stage. Common *Fluminicola*, sphaeriids; uncommon lymnaeids, *Physella*. Dip net collections. 4/27/1995 TF, EJ, SW! [B85]

107. [2242] Cold Spring north of Lodgepole Picnic Area. Zone 10: 570,820E 4,743,350N. Unsurveyed area, legal coordinates not possible., Union Peak 1985 quad., Klamath Co. Annie Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Cold Spring just N. of Lodgepole Picnic Area, E. side of OR 62 (Crater Lake Highway), S. of Crater Lake, Crater Lake National Park. Elev. 5850'. Depth 0-4". Cold spring in narrow open meadow with abundant sedge; some basalt and pumice cobbles; mud; no macrophytes; surrounded by *Pinus/Populus* forest. No mollusks seen. Hand and dip net attempted. 10/20/1995 TF, EJ, JJ!
[B94]

108. [2243] Annie Spring north of Mazama Campground. Zone 10: 567,960E 4,746,760N. Unsurveyed area, coordinates not possible., Union Peak 1985 quad., Klamath Co. Annie Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Annie Spring N. of Mazama Campground, source of Annie Creek, S. of Crater Lake, Crater Lake National Park. Elev. 6000'. Depth 1-9". Cold spring with silt-cobble substrate (mostly pumice and ash debris). No macrophytes. No mollusks. Dip net and hand collections attempted. Spring modified at source (in concrete box) and partially diverted for water supply for campground. 10/20/1995 TF, EJ, JJ! [B94]

109. [2244] Annie Creek above bridge of FS 6237. Zone 10: 577,120E 4,734,810N. Unsurveyed area, coordinates not possible., Maklaks Crater 1985 quad., Klamath Co. Annie Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Annie Creek just upstream (W.) of bridge of FS 6237 and USGS gauging station, E. of OR 62 (Crater Lake Highway), Winema National Forest. Elev. 4335'. Depth 0-37". Large cold creek with unstable substrate (mostly ash and pumice); some wood present. No macrophytes. No mollusks. Dip net collection attempted. 10/20/1995 TF, EJ, JJ! [B66]

110. [2246] Cedar Spring west of Wildcat Creek. Zone 10: 574,420E 4,737,120N. Unsurveyed area, coordinates not possible., Maklaks Crater 1985 quad., Klamath Co. Wild Creek-Annie Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Cedar Spring W. of Wildcat Creek, N. of FS 3212, Winema National Forest. Elev. 4720'. Dry spring; in recently cut *Pinus*/spruce forest; mostly ash and pumice with some basalt in regolith. No mollusks. 10/20/1995 TF, EJ, JJ! [B66]

111. [2247] North Calimus Spring north of Williamson River Road. Zone 10: 614,140E 4,723,160N. NE¼ SE¼ SE¼ SW¼ NE¼ sec. 2, T34S R9E, Calimus Butte 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. North Calimus Spring 0.1 mi. N. of Williamson River Road (Klamath County 600; FS 45), Winema National Forest. Elev. 4600'. Depth 0-8". Cold spring, mostly mud; no macrophytes. No mollusks. Dip net collection attempted. Heavily grazed; dug out and channeled into pool. 10/21/1995 TF, EJ! [B25]

112. [2248] Unnamed spring southwest of North Calimus Spring. Zone 10: 613,120E 4,721,920N. SE¼ SW¼ NW¼ NW¼ sec. 11, T34S R9E, Calimus Butte 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring *ca.* 1.2 mi. SW of North Calimus Spring, N. of Williamson River Road (Klamath County 600; FS 45) 0.2 mi., off FS 4526 at the end of FS 4526-020, Winema National Forest. Elev. 4580'. Depth 0-1". Cold spring, mostly mud; no macrophytes. Almost dry. No mollusks; dip net collection attempted. 10/21/1995 TF, EJ! [B25]

113. [2249] Unnamed spring northeast of North Calimus Spring. Zone 10: 616,600E 4,724,345N. Center SW¼ sec. 31, T33S R10E, Calimus Butte 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring *ca.* 3.4 mi. NE of North Calimus Spring, just east of the junction of Williamson River Road (Klamath County 600; FS 45) and FS 4546, Winema National Forest. Elev. 5225'. Depth 0-1". Small cold spring channeled into pond; mud substrate; no macrophytes. Dip net attempted; no mollusks. 10/21/1995 TF, EJ! [B25]

114. [2250] Springs at head of the Williamson River. Zone 10: 629,530E 4,732,040N. NE¼ NE¼ NE¼ NE¼ NW¼ sec. 9, T33S R11E, Fuego Mtn. 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Three springs at the head of the Williamson River at E. end of Head of the River Campground, 0.45 mi. along FS 4648 N. of junction of

Williamson River Road (Klamath County 600; FS 45), Winema National Forest. Elev. 4600'. Depth 0-6". Medium-sized cold spring (3); mud and pumice gravel substrate; abundant *Rorippa*; some epiphytic algae. Sphaeriids common; dip net collections. Relatively intact; partly fenced. 10/21/1995 TF, EJ! [B44]

115. [2251] Spring on south side of run at head of the Williamson River. Zone 10: 629,420E 4,731,960N. NW¼ SE¼ NE¼ NE¼ NW¼ sec. 9, T33S R11E, Fuego Mtn. 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Cold spring on S. side of large spring run at the head of the Williamson River and 0.15 mi. SW of eastern terminal springs, W. end of Head of the River Campground, 0.45 mi. along FS 4648, N. of junction of Williamson River Road (Klamath County 600; FS 45), Winema National Forest. Elev. 4600'. Depth 0-6". Medium-sized cold spring; mud and pumice gravel substrate; abundant *Rorippa*; some epiphytic algae. Sphaeriids and *Physella* hand and dip net collected. 10/21/1995 TF, EJ! [B44]

116. [2252] Spring run at head of the Williamson River. Zone 10: 629,340E 4,731,960N. NW¼ SW¼ NE¼ NE¼ NW¼ sec. 9, T33S R11E, Fuego Mtn. 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Large spring run at the head of the Williamson River and 0.2 mi. W. of eastern terminal springs, W. end of Head of the River Campground, 0.45 mi. along FS 4648, N. of junction of Williamson River Road (Klamath County 600; FS 45), Winema National Forest. Elev. 4595'. Depth 2-18". Large cold spring run; mud, pumice sand and gravel; local basalt cobbles; local epiphytic algae and *Myriophyllum*, *Potamogeton filiformis*. Rare *Physella*; common sphaeriids; local *Vorticifex*. 10/21/1995 TF, EJ! [B44]

117. [2253] Sprague River 0.7 road mile on Williamson River Road. Zone 10: 600,530E 4,718,100N. SW¼ SE¼ SE¼ SW¼ NW¼ sec. 21, T34S R5E, Chiloquin 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sprague River on NW side about 0.7 rd. mi. from Sprague River Road (FS 58) on Williamson River Road (Klamath County 600; FS 45), Winema National Forest. Elev. 4250'. Depth 2-16". Strongly eutropified medium-sized river; dense *Ceratophyllum* and *Potamogeton crispus*; abundant epiphytic algae; mostly mud substrate. Uncommon *Fluminicola*; common planorbids, *Physella*, *Lymnaea stagnalis*. Dip net and tray collected. 10/21/1995 TF, EJ, JJ! [B30]

118. [2254] Sprague River below Cave Mountain. Zone 10: 596,240E 4,715,680N. NE¼ SE¼ SE¼ SE¼ SW¼ sec. 25, T34S R7E, Chiloquin 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sprague River on N. side below Sprague River Road (FS 58), below (S. of) Cave Mountain 0.9 rd. mi. NE of junction with FS 5810, Winema National Forest. Elev. 4220'. Depth 2-14". Medium-size river; cobble-boulder substrate, mostly cemented; scattered *Potamogeton crispus*, *Potamogeton filiformis*, and *Ceratophyllum*. *Fluminicola*, rare *Lanx*. Dip net, brush and tray collection. Nutrient-enriched river. 10/21/1995 TF, EJ! [B29]

119. [2255] Sycan River at south end of Teddy Power Meadow. Zone 10: 635,020E 4,722,460N. NE¼ NE¼ NW¼ NE¼ sec. 12, T34S R11E, Silver Dollar Flat 1988 quad., Klamath Co. Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sycan River just S. of Teddy Powers Meadow, near ford of FS 347, Fremont National Forest. Elev. 4820'. Depth 1-38". Eutrophic small river; mud, sand, cobble; local deep pools; abundant epiphytic algae, *Ceratophyllum*, *Potamogeton crispus*; local *Elodea*. Uncommon dead *Anodonta*; Uncommon live *Valvata humeralis*; *Radix*; *Lymnaea stagnalis appressa*. Collected by dip net and hand. Eutropified; badly grazed. 10/22/1995 TF, EJ! [B82]

120. [2256] Unnamed spring tributary to Blue Creek. Zone 10: 639,600E 4,717,940N. Center NE¼ SW¼ SW¼ SE¼ sec. 21, T34S R12E, Spodue Mtn. 1988 quad., Klamath Co. Blue Creek-

Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring to E. of FS 347 0.5 mi. from junction with FS 3462, Fremont National Forest. Elev. 4960'. Dry spring. No mollusks. 10/22/1995 TF, EJ! [B88]

121. [2257] Snake Creek unnamed spring 1. Zone 10: 642,770E 4,706,940N. NW¼ NW¼ NE¼ SE¼ SW¼ sec. 26, T35S R17E, Spodue Mtn. 1988 quad., Klamath Co. Snake Creek-Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Unnamed spring in pasture 0.1 mi. N. of Snake Creek and 0.1 mi. E. of Godowa Springs Road (Klamath County 1193). Elev. 4345'. Depth 0-2". Spring with mud substrate; no macrophytes. No mollusks; dip net collection attempted. Very badly pastured. 10/22/1995 TF, EJ! [B89]

122. [2258] Snake Creek unnamed spring 2. Zone 10: 642,710E 4,706,920N. NE¼ NE¼ NW¼ SE¼ SW¼ sec. 26, T35S R17E, Spodue Mtn. 1988 quad., Klamath Co. Snake Creek-Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Unnamed spring in pasture 0.1 mi. N. of Snake Creek and *ca.* 500' E. of Godowa Springs Road (Klamath County 1193). Elev. 4345'. Depth 0-2". Spring with mud substrate; no macrophytes. No mollusks. 10/22/1995 TF, EJ! [B89]

123. [2259] Snake Creek unnamed spring 3. Zone 10: 642,640E 4,706,930N. NE¼ NW¼ NW¼ SE¼ SW¼ sec. 26, T35S R17E, Spodue Mtn. 1988 quad., Klamath Co. Snake Creek-Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Unnamed spring in pasture 0.1 mi. N. of Snake Creek and 500' W. of Godowa Springs Road (Klamath County 1193). Elev. 4345'. Depth 0-2". Spring with mud substrate; no macrophytes. No mollusks. 10/22/1995 TF, EJ! [B89]

124. [2260] Snake Creek east of Godowa Springs Road. Zone 10: 642,660E 4,706,810N. NW¼ SE¼ NW¼ SE¼ SW¼ sec. 26, T35S R17E, Spodue Mtn. 1988 quad., Klamath Co. Snake Creek-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Snake Creek just E. of Godowa Springs Road (Klamath County 1193). Elev. 4340'. Depth 0-2". Small creek; mostly mud substrate with scattered cobbles; *Ceratophyllum*. No mollusks. 10/22/1995 TF, EJ! [B89]

125. [2261] Robin Spring. Zone 10: 620,800E 4,696,560N. Center NW¼ NE¼ NW¼ NE¼ sec. 33, T36S R10E, Sprague River West 1985 quad., Klamath Co. Cherry Creek-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Robin Spring E. of FS 320, about 0.25 rd. mi. S. from Squaw Flat Road (Klamath County 1101), Winema National Forest. Elev. 4710'. Depth 1-4". Cold spring with mud substrate. *Gyraulus* dip net collected. Spring troughed at source, dug out below and blocked by small earthen dam. Area heavily grazed; forest burned. 10/22/1995 TF, EJ! [B90]

126. [2262] Unnamed spring east of Robin Spring. Zone 10: 621,920E 4,697,380N. Sprague River West 1985 quad., Klamath Co. Cherry Creek-Sprague River-Williamson River-Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed springs *ca.* 1.0 mi. NE of Robin Spring and 0.2 rd. mi. S. up and (E. of) FS 1119 from Squaw Flat Road (Klamath Co. 1101), Winema National Forest. Elev. 4760'. Depth 0-4". Small cold spring with dense but local *Rorippa*; myrtle; *Salix*; *Cornus stolonifera*; predominantly mud substrate; grasses. Sphaeriids in spring dip net collected. *Discus*, slugs, etc. hand collected. Partly fenced by barb wire fence. Area burned over; partly grazed. 10/22/1995 TF, EJ! [B90]

127. [2263] Unnamed spring south of Modoc Point. Zone 10: 594,020E 4,698,060N. Quarter sections not practical; sec. 6, T37S R8E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Small unnamed spring W. of S. P. R. R. track and US

97 at rd. mi. 258.9, in Upper Klamath Lake, *ca.* 1.1 mi. S. of Modoc Point below Modoc Rim. Elev. 4140'. Depth 4-28". Spring-influenced lake; mostly basalt cobble substrate; common green and brown algae near shore; no macrophytes; common floating blue-green algae. Common large *Fluminicola*; uncommon *Pyrgulopsis archimedis*, *Lyogyrus*; common *Vorticifex klamathensis klamathensis*. Dip net, tray and brush collected. Spring submerged during high water. 10/23/1995 TF, EJ! [B73]

128. [2264] Barkley Spring discharge channel. Zone 10: 597,740E 4,693,000N. Quarter sections not practical; sec. 1 T37S R8E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Discharge channel of Barkley Spring within 100' of culvert under S. P. R. R. track (S. of culvert) and 0.1 mi. S. of Algoma Road/US 97 junction, NW of Hagelstein County Park, Winema National Forest. Elev. 4143'. Depth 2-32". Spring channel with mostly mud-gravel (including pumice); abundant wood and plant debris; uncommon floating blue-greens; local boulders and cobbles; local deep pools. Abundant sphaeriids, *Pisidium ultramontanum*; common *Pisidium insigne* and *Valvata humeralis* locally; rare *Fluminicola* sp. and *Anodonta*. Snails and clams moderately common at top of mud bar in macrophytes and near shore. 10/23/1995 TF, EJ! [B72]

129. [2265] Upper Klamath Lake north of Barkley Spring outlet. Zone 10: 597,670E 4,693,050N. Quarter sections not possible; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Upper Klamath Lake just N. of outlet from Barkley Spring, W. of S. P. R. R. track (N. of bridge) and US 97, NW of Hagelstein County Park, Winema National Forest. Elev. 4140'. Depth 4-28". Large lake at outlet delta; common boulders, cobble, gravel (mixed basalt and red pumice); no macrophytes; abundant blue-green algae floating; common epiphytic algae near shore. Common *Fluminicola*, large and small; common *Vorticifex klamathensis klamathensis*; uncommon *Physella*, *Pyrgulopsis archimedis*. Dip net, tray and brush collection. Lake strongly influenced by spring discharge. 10/23/1995 TF, EJ! [B72]

130. [2266] Link River below Fremont Bridge. Zone 10: 598,610E 4,676,680N. SE¼ SE¼ SE¼ NE¼ NW¼ sec. 30, T38S R9E, Klamath Falls 1985 quad., Klamath Co. Link River-Lake Ewauna-Klamath River. Link River on W. side at Pacific Power and Light Link River wildlife trail S. of Fremont Bridge (Oregon Avenue). Elev. 4140'. Depth 4-16". Mixed mud, pumice and basalt gravel, cobbles and boulders; impounded lake outlet; no macrophytes; common floating blue-green; common epiphytic algae. Taylor site T59-119 collected on Oct. 4, 1959. W. O. Gregg site 7910. Common *Vorticifex klamathensis klamathensis*; rare *Vorticifex effusus dalli*; uncommon large *Fluminicola*, *Physella*. Collected by dip net and tray. Well-used fishing access; heavy waterfowl usage. 10/23/1995 TF, EJ! [B54]

131. [2267] Unnamed spring east of Big Bend. Zone 10: 578,860E 4,660,280N. Projected from NW corner; SW¼ NE¼ SW¼ NW¼ sec. 18, T40S R7E, Chicken Hills 1986 quad., Klamath Co. Klamath River Unnamed spring W. of Topsy Grade Road, *ca.* 2.8 mi. S. of Boyle Campground and on Klamath Rim E. of Big Bend. Elev. 4160'. Depth 0-6". Abundant epiphytic algae; mostly mud (with rare cobble) substrate; common *Potamogeton crispus*, and *Myriophyllum*. Rare *Pisidium variabile* only, not collected. Dip net used. 10/25/1995 TF, EJ! [B28]

132. [2268] Unnamed spring near site of Topsy. Zone 10: 576,500E 4,653,300N. NW¼ sec. 2, T41S R6E, Chicken Hills 1986 quad., Klamath Co. Klamath River. Unnamed spring source and run on Klamath Rim (S. side) at former site of Topsy (near intersection of Topsy Grade Road and Picard Road). Elev. 4130'. Depth 0-4". Mud substrate with rare basalt cobbles; patchy myrtle, *Rorippa*, and *Myriophyllum*. Dug out pool at source. *Gyraulus* and *Stagnicola* collected by dip net. No sphaeriids. 10/25/1995 TF, EJ! [B27]

133. [2275] East Branch Lost River. Zone 10: 656,290E 4,651,880N. N½ NW¼ NW¼ NW¼ NW¼ sec. 19, T41S R14 ½E, Brady Butte 1988 quad., Klamath Co. E. Branch Lost River-Lost River-Lower Klamath Lake. East Branch Lost River at Willow Valley Road crossing below Willow Valley Reservoir, BLM lands. Elev. 4505'. Depth 1-4". Small shallow muddy river channel with sporadic bedrock and cobbles; common *Ceratophyllum* and rare *Potamogeton crispus*. Common sphaeriids; also *Physella, Radix*. Collected by hand and dip net. Mostly dewatered; grazed. 10/26/1995 TF, EJ! [B20]

134. [2276] Duncan Spring-north complex. Zone 10: 659,020E 4,656,920N. NE¼ NE¼ NW¼ NW¼ SW¼ sec. 4, T41S R14 ½E, Brady Butte 1988 quad., Klamath Co. Antelope Creek-East Branch Lost River-Lost River-Lower Klamath Lake. Duncan Spring NW-most spring complex in Duncan Riparian Restoration Project (BLM), at head of Antelope Creek. Elev. 4730'. Depth 0-4". Cold springs with cobble and boulder (basalt) substrate, with minor fines; emergent macrophytes (mostly *Cicuta*), some bryophytes. Abundant *Fluminicola*, minor sphaeriids. Dip net collected. Moderately grazed. 10/26/1995 TF, EJ! [B21]

135. [2277] Duncan Spring-south complex. Zone 10: 659,980E 4,655,960N. SW¼ NW¼ NE¼ NE¼ SW¼ sec. 4, T41S R14 ½E, Brady Butte 1988 quad., Klamath Co. Antelope Creek-East Branch Lost River-Lost River-Lower Klamath Lake. Duncan Spring S. spring complex in Duncan Riparian Restoration Project (BLM), at head of Antelope Creek, old road crosses at rough midpoint of spring runs. Elev. 4730'. Depth 0-4". Large shallow cold springs with boulder, cobble, and minor fine substrate; abundant *Mimulus*, local *Cicuta* and *Rorippa*; minor bryophytes. Abundant *Fluminicola*; some land snails. Hand and dip net collections. 10/26/1995 TF, EJ! [B22]

136. [2278] Unnamed springs south of Duncan Spring. Zone 10: 660,060E 4,655,890N. SW¼ SE¼ NE¼ NE¼ sec. 4, T41S R14 ½E, Brady Butte 1988 quad., Klamath Co. Antelope Creek-E. Br. Lost River-Lost River-Lower Klamath Lake. Small unnamed spring with 4 runs, *ca.* 0.15 mi. SE of Duncan Spring, Duncan Riparian Restoration Project (BLM), near head of Antelope Creek. Elev. 4730'. Depth 0-2". Small very shallow cold springs with mixed mud-basalt cobble substrate; multiple runs from same source; grassy; some bryophytes; no macrophytes. Springs not shown on USGS map. Rare medium-sized *Fluminicola* collected by dip net. Grazing impacted. 10/26/1995 TF, EJ! [B22]

137. [2279] Antelope Creek below Duncan Spring. Zone 10: 660,090E 4,655,800N. SW¼ NE¼ SE¼ NE¼ SW¼ sec. 4, T41S R14 ½E, Brady Butte 1988 quad., Klamath Co. Antelope Creek-E. Br. Lost River-Lost River-Lower Klamath Lake. Antelope Creek near head, below Duncan Spring, Duncan Riparian Restoration Project (BLM). Elev. 4720'. Depth 2-8". Moderate-sized very cold creek; sand, gravel, and cobble substrate; with travertine deposition; common epiphytic algae, *Potamogeton crispus, Potamogeton filiformis, Ceratophyllum*; rare *Myriophyllum*. Abundant large and medium *Fluminicola*, rare sphaeriids. Collected by dip net. 10/26/1995 TF, EJ! [B22]

138. [2280] Rock Creek unnamed north head spring. Zone 10: 668,950E 4,652,970N. SE¼ NE¼ NW¼ NW¼ SE¼ sec. 17, T41S R15E, Antler Point 1988 quad., Klamath Co. Rock Creek-Lost River-Lower Klamath Lake. Unnamed spring in head of Rock Creek, *ca.* 0.2 mi. N. of Gwinn Creek Road (BLM 6188) bridge over Rock Creek, BLM lands. Elev. 4870'. Depth 1-10". Small cold creek; boulder-mud substrate; abundant epiphytic algae; local *Ceratophyllum* and *Myriophyllum*; some deep pools. Scattered *Radix*; *Stagnicola*; *Gyraulus*; *Physella*; sphaeriids. Hand and dip net collected. Area heavily grazed. 10/26/1995 TF, EJ! [B8]

139. [2281] Rock Creek unnamed south head spring. Zone 10: 668,500E 4,652,660N. SW¼ SE¼ SW¼ NW¼ SE¼ sec. 17, T41S R15E, Antler Point 1988 quad., Klamath Co. Rock Creek-Lost

River-Lower Klamath Lake. Unnamed spring to the W. of Rock Creek, *ca.* 0.1 mi. S. of Gwinn Creek Road (BLM 6188) bridge over Rock Creek, BLM lands. Elev. 4860'. Depth 1-10". Small cold creek; boulder-mud substrate; abundant epiphytic algae; local *Ceratophyllum* and *Myriophyllum*; some deep pools. Scattered *Radix*; *Stagnicola*; *Gyraulus*; *Physella*; sphaeriids. Hand and dip net collections. Area heavily grazed. 10/26/1995 TF, EJ! [B8]

140. [2282] Gwinn Spring Creek unnamed spring 1. Zone 10: 669,190E 4,652,330N. NW¼ SW¼ SE¼ SW¼ SW¼ sec. 16, T41S R15E, Antler Point 1988 quad., Klamath Co. Gwinn Spring Creek-Rock Creek-Lost River-Lower Klamath Lake. Unnamed spring in pasture, NW side of Gwinn Spring Creek and on S. side of Gwinn Spring Creek Road (BLM 6188). Elev. 4910'. Depth 0-2". Small cold spring in grassy pasture; muddy substrate; no macrophytes. No mollusks; heavily grazed. Dip net collection attempted. 10/26/1995 TF, EJ! [B8]

141. [2283] Gwinn Spring Creek unnamed spring 2. Zone 10: 669,580E 4,652,240N. SE¼ SE¼ SE¼ SW¼ SW¼ sec. 16, T41S R15E, Antler Point 1988 quad., Klamath Co. Gwinn Spring Creek-Rock Creek-Lost River-Lower Klamath Lake. Unnamed spring on S. side of Gwinn Spring Creek and Gwinn Spring Creek Road (BLM 6188). Elev. 4910'. Depth 0-2". Small cold spring with a muddy substrate; no macrophytes. No mollusks; dip net collected. Heavily impacted by grazing. 10/26/1995 TF, EJ! [B8]

142. [2284] Unnamed springs opposite Big Springs City Park. Zone 10: 632,190E 4,672,700N. Center SE¼ NE¼ SE¼ SW¼ sec. 10, T39S R11E, Bonanza 1988 quad., Klamath Co. Lost River-Lower Klamath Lake, Yonna Valley. Several small springs on NW side of island in Lost River opposite (E. of) Big Springs City Park, Bonanza. Elev. 4120'. Depth 4-10". Several small spring runs; abundant *Rorippa*, *Mimulus*; offshore *Veronica*, *Myriophyllum*, *Elodea*, *Ceratophyllum*, *Potamogeton crispus*. Abundant *Pyrgulopsis*; common *Fluminicola*, sphaeriids; uncommon *Planorbella*, *Physella*, *Vorticifex*. Dip net collection. Relatively unmodified; some runs on island, others originate in river. 10/26/1995 TF, EJ! [B18]

143. [2285] Lost River at Big Springs City Park. Zone 10: 632,150E 4,672,660N. NE¼ NW¼ SE¼ SE¼ SW¼ sec. 10, T39S R11E, Bonanza 1988 quad., Klamath Co. Lost River-Lower Klamath Lake, Yonna Valley. Lost River at Horsefly Irrigation District weir and downstream, S. edge of Big Springs City Park, Bonanza. Elev. 4120'. Depth 6-18". Medium-sized, eutrophic but spring-fed river; abundant *Potamogeton filiformis*, *Elodea*; common *Potamogeton crispus*, *Ceratophyllum*, epiphytic algae; uncommon *Veronica*; mud, sand, gravel, and cobble substrate. Abundant *Pyrgulopsis*; common *Fluminicola*; uncommon sphaeriids, *Physella*, *Planorbella*, small *Vorticifex*. 10/26/1995 TF, EJ! [B18]

144. [2286] First spring south of Big Springs. Zone 10: 632,190E 4,672,760N. Center NE¼ SE¼ SW¼ sec. 10, T39S R11E, Bonanza 1988 quad., Klamath Co. Lost River-Lower Klamath Lake, Yonna Valley. Spring run just S. of main spring run of Big Springs on NE end of Big Springs City Park, Bonanza, W. side of Lost River. Elev. 4120'. Depth 0-4". Shallow cold spring run; predominantly mud and sand substrate; abundant *Rorippa*, common *Mimulus*. Common *Pyrgulopsis*; rare *Physella*, sphaeriids. Collected by dip net. 10/26/1995 TF, EJ! [B18]

145. [2287] Second spring south of Big Springs. Zone 10: 632,160E 4,672,720N. NW¼ SE¼ NE¼ SE¼ SW¼ sec. 10, T39S R11E, Bonanza 1988 quad., Klamath Co. Lost River-Lower Klamath Lake, Yonna Valley. First spring run N. of Horsefly Irrigation District weir (W. side of Lost River) and second spring run just S. of main spring run of Big Springs on NE end of Big Springs City Park, Bonanza. Elev. 4120'. Depth 0-10". Shallow composite cold spring runs; mud, sand, and cobble substrate; abundant *Rorippa*, uncommon *Mimulus*; *Potamogeton crispus* and *Potamogeton filiformis*. Common *Pyrgulopsis*; rare *Fluminicola*, sphaeriids, and *Physella*. Collected by dip net. Partly filled in but mostly intact. 10/26/1995 TF, EJ! [B18]

146. [2288] Spencer Creek below Buck Lake. Zone 10: 569,440E 4,679,330N. SW¼ SW¼ SW¼ SW¼ NE¼ sec. 18, T38S R11E, Lake of the Woods South 1985 quad., Klamath Co. Spencer Creek-Klamath River. Spencer Creek below Buck Lake and just W. of Clover Creek Road, Winema National Forest. Elev. 4120'. Depth 0-10". Large cold creek; local macrophytes (*Elodea*, *Myriophyllum*); range from fine to cobble substrate; uncommon epiphytic algae. Common sphaeriids; dip net and hand collected. Recent modifications to enhance fish habitat. 10/27/1995 TF, EJ! [B61]

147. [2289] Unnamed north Buck Lake spring. Zone 10: 565,980E 4,680,230N. Center SE¼ SW¼ sec. 11, T38S R5E, Lake of the Woods South 1985 quad., Klamath Co. Buck Lake-Spencer Creek-Klamath River. Unnamed spring on NW edge of Buck Lake, Winema National Forest. Elev. 4950'. Depth 2-6". Sedge meadow with shallow spring runs; sedges, *Aconitum*, *Saxifraga*; *Rorippa* local; mud substrate; common wood. Sphaeriids only, not retained. Dip net collected. Heavily grazed. 10/27/1995 TF, EJ! [B61]

148. [2290] Unnamed middle Buck Lake spring. Zone 10: 565,900E 4,679,260N. SW¼ SE¼ SW¼ SE¼ NW¼ sec. 14, T38S R5E, Lake of the Woods South 1985 quad., Klamath Co. Buck Lake-Spencer Creek-Klamath River. Unnamed spring on center W. side of Buck Lake. N.-most of two springs. Elev. 4940'. Depth 0-4". Sedge meadow with shallow spring runs; mostly mud substrate with scattered basalt cobbles; no macrophytes or epiphytic algae; abundant downed wood. Dip net collection; sphaeriids only, not retained. Very heavily grazed and degraded. 10/27/1995 TF, EJ! [B61]

149. [2291] Buck Lake-south most unnamed spring. Zone 10: 565,845E 4,679,040N. SW¼ SW¼ NW¼ NE¼ SW¼ sec. 14, T38S R5E, Lake of the Woods South 1985 quad., Klamath Co. Buck Lake-Spencer Creek-Klamath River. S. most of two unnamed springs on center W. side of Buck Lake. Elev. 4940'. Depth 4-18". Basalt knob with spring at base; mostly dug out and in peripheral Buck Lake channel; mostly fine substrate; local cobble and large wood fragments; no macrophytes and rare epiphytic algae; common bryophytes very local. Uncommon small *Fluminicola* and sphaeriids at source only. Dip net collection. 10/27/1995 TF, EJ! [B61]

150. [2292] Buck Lake peripheral channel. Zone 10: 566,080E 4,679,940N. Center NE¼ NE¼ NW¼ sec. 14, T38S R5E, Lake of the Woods South 1985 quad., Klamath Co. Buck Lake-Spencer Creek-Klamath River. Unnamed spring channel on NW side of Buck Lake at wooden bridge and at NE terminus of access road. Elev. 4940'. Depth 4-24". Swift spring-fed channel; predominantly fine (mud) substrate; abundant but local bryophytes; *Myriophyllum*; *Potamogeton filiformis*; *Potamogeton crispus*; *Ceratophyllum*. Common *Fluminicola* but very local, snails only on rocks of bridge. Dip net and hand collection. Most of channel dug out, fine substrate, chironomids, sphaeriids only or no mollusks. 10/27/1995 TF, EJ! [B61]

151. [2293] Johnson Creek above crossing of Surveyor Meadows Road. Zone 10: 562,910E 4,676,610N. SE¼ SW¼ NE¼ NE¼ NW¼ sec. 28, T38S R5E, Surveyor Mountain 1985 quad., Klamath Co. Johnson Creek-Jenny Creek-Klamath River. Johnson Creek collected just above Surveyor Meadows Road crossing (BLM 38-5E-28.1), BLM lands. Elev. 5140'. Depth 1-5". Shallow large spring-fed creek; predominantly basalt cobble an mud substrate; locally common bryophytes; rare epiphytic algae; extremely patchy *Rorippa*; local pools, common deciduous leaves. Uncommon small *Fluminicola* above road only; absent in BLM pool SW of road crossing and in creek for 100' below pool; sphaeriids in both areas. Modified below road crossing; burned and partly logged to the NW. 10/27/1995 TF, EJ! [B93]

152. [2294] Unnamed spring at Surveyor Mountain Campground. Zone 10: 563,680E 4,677,530N. SE¼ NW¼ NE¼ NE¼ SE¼ sec. 21, T38S R5E, Surveyor Mountain 1985 quad.,

Klamath Co. Johnson Creek-Jenny Creek-Klamath River. Fenced unnamed spring in BLM Surveyor Mountain Campground off Keno Road. Elev. 5150'. Depth 0-2". Cold spring with cobble and mud substrate; minor *Rorippa* and bryophytes below road (Surveyor Mountain Campground). *Pisidium casertanum* and *insigne* only; not retained. Dip net and hand collection attempted. Spring fenced but modified, piped at source. 10/27/1995 TF, EJ! [B93]

153. [2295] Unnamed spring east of Johnson Creek. Zone 10: 562,815E 4,676,145N. SW¼ NE¼ SW¼ SE¼ NW¼ sec. 28, T38S R5E, Surveyor Mountain 1985 quad., Klamath Co. Unnamed Run-Johnson Creek-Jenny Creek-Klamath River. Unnamed spring and run 0.2 mi. SE of Johnson Creek, 0.3 mi. S. of Surveyor Meadows Road bridge on Johnson Creek, BLM lands. Elev. 4940'. Depth 2-4". Spring run source; mostly basalt boulder and mud substrate; no macrophytes; brown epiphytic algae; open grassy meadow (trees logged). No mollusks. 10/27/1995 TF, EJ! [B93]

154. [2296] Cold Creek southwest of Surveyor Mountain. Zone 10: 564,150E 4,673,270N. Center NW¼ sec. 3, T39S R5E, Surveyor Mountain 1985 quad., Klamath Co. Cold Creek-Johnson Creek-Jenny Creek-Klamath River. Cold Creek just above BLM access road, SW side of Surveyor Mountain, BLM lands. Elev. 4960'. Depth 0-6". Spring-fed cold creek; steep cobble substrate; abundant bryophytes; local *Rorippa* and *Mimulus*; in partly open old-growth forest remnant. *Pisidium casertanum* only, not retained. Dip net and hand. 10/27/1995 TF, EJ! [B93]

155. [2297] Unnamed spring south of Blue Springs. Zone 10: 575,720E 4,726,900N. NW¼ SW¼ NE¼ SE¼ SE¼ sec. 23, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Upper Klamath Lake-Lake Ewauna-Klamath River, Wood River Valley. Unnamed spring 0.5 mi. S. of Blue Springs on Short Creek, E. of FS 3300, inholding in Winema National Forest. Elev. 4180'. Depth 0-4". Small cold spring mostly choked with wood; cobble (red basalt)-mud substrate; shallow; no macrophytes. Spring not shown on USGS map. Uncommon small *Fluminicola* n. sp. and sphaeriids. Dip net and tray collections. Very limited *Vespericola sierranus* colony (*ca.* 30 square ft.) at source. Hand collected. Heavily grazed and with logging debris. 10/28/1995 TF, EJ! [B67]

156. [2298] Blue Springs 1.0 mile south of Nicholson Road. Zone 10: 575,800E 4,727,070N. Center W½ SE¼ SE¼ NE¼ SE¼ sec. 23, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co. Short Creek-Sevenmile Creek-Upper Klamath Lake-Lake Ewauna-Klamath River, Wood River Valley. Blue Springs on E. side of FS 3300, 1.0 mi. S. of Nicholson Road, Winema National Forest. Elev. 4160'. Depth 0-4". Several small springs draining into impoundment, cobble (basalt)-mud substrate; uncommon bryophytes, dead leaves; common wood fragments; choked with mud and logs. Uncommon *Fluminicola* and sphaeriids in limited areas above regulated impoundment (pond). Collected by dip net. 10/28/1995 TF, EJ! [B67]

157. [2299] Upper Klamath Lake on west side Eagle Ridge. Zone 10: 585,640E 469,460N. SW¼ SW¼ SW¼ SW¼ SE¼ sec. 23, T36S R7E, Shoalwater Bay 1985 quad., Klamath Co. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Shoalwater Bay on E. side in Upper Klamath Lake, *ca.* 1.0 mi. NW of Eagle Ridge County Park along Eagle Point Road, W. side of Eagle Ridge, Winema National Forest. Elev. 4160'. Depth 2-38". Spring-influenced large lake; common blue-green algae; cobble-substrate with minor fines; no macrophytes; common epiphytic algae. Abundant *Vorticifex klamathensis klamathensis*; very rare and local *Pyrgulopsis archimedis, Pisidium ultramontanum, Fluminicola*; common *Physella*. Dip net and tray collection. Hypetrophic lake; mollusks locally abundant. 10/28/1995 TF, EJ! [B81]

158. [2300] Side channel near Point Comfort. Zone 10: 574,600E 4,702,140N. Projected NW corner; SE¼ NW¼ SE¼ NE¼ sec. 3, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Channel near SE terminus of Dugout Lane, *ca.* 0.4 mi. NE of Harriman Springs just SW of Point Comfort and near junction with

Fourmile Creek. Elev. 4150'. Depth 6-36". Spring-fed deep channel; mud over peat substrate; dug out; abundant local macrophytes (*Potamogeton crispus*; *Ceratophyllum*). Common sphaeriids; uncommon *Physella*; rare *Carinifex*. Dip net and tray collection. 10/28/1995 TF, EJ! [B78]

159. [2301] Sevenmile Creek at terminus of FS 3334. Zone 10: 569,750E 4,727,520N. Devils Peak 1985 quad., Klamath Co. Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sevenmile Creek at Sevenmile Creek trailhead (#3703), *ca.* 6.0 mi. W. on FS 3334 (at terminus) from Nicholson Road-FS 3300 junction, Winema National Forest. Elev. 5460'. Depth 0-4". Very cold medium-sized creek; mud-cobble-boulder substrate; common bryophytes and uncommon epiphytic algae; small *Nostoc* and *Rivularia*. No mollusks; dip net and hand collections attempted. Horse trail crossing; but relatively pristine. 10/29/1995 TF, EJ! [B36]

160. [2302] Sevenmile Creek near RM 1.9. Zone 10: 574,320E 4,730,520N. Mares Egg Spring 1985 quad., Klamath Co. Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sevenmile Creek N. of FS 3334 at RM 1.9, Winema National Forest. Elev. 4320'. Depth 4-16". Large swift cold creek with cobble-mud substrate, some deep pools; abundant wood fragments and pine needles; common bryophytes; in nearly closed-canopy forest; small *Nostoc*. Sphaeriids only, not retained (*Pisidium casertanum*, *Pisidium variabile*). Dip net collected. Road crossing in creek bed; but excellent condition. 10/29/1995 TF, EJ! [B69]

161. [2303] Sevenmile Creek at Sevenmile Creek Forest Service Station. Zone 10: 575,820E 4,728,380N. Mares Egg Spring 1985 quad., Klamath Co. Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Sevenmile Creek W. of Sevenmile Creek Forest Service Station, 0.15 mi. N. of Nicholson Road, Winema National Forest. Elev. 4193'. Depth 4-34". Large, deep creek in grassy clearing; mud-cobble substrate; common leaves, needles, and downed logs. Common sphaeriids, not retained (*Pisidium variabile*, *Pisidium casertanum*, *Pisidium insigne*). Dip net collected. 10/29/1995 TF, EJ! [B69]

162. [2304] Denny Creek-north spring near source. Zone 10: 579,805E 4,689,500N. Aspen Lake 1985 quad., Klamath Co. Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring runs in N. end of Denny Creek source area, on opposite (E. side) of Weyerhaeuser road from spring source. Elev. 4390'. Depth 0-4". Glade with several spring channels; range from mud-cobble substrate; common *Myriophyllum*, bryophytes; local *Rorippa*, *Mimulus*; meadow with *Aconitum*, *Pyrola*, *Saxifraga*. Rare small *Fluminicola*, sphaeriids. Collected by dip net. Area badly grazed; only 1 run (S.-most) with *Fluminicola* in limited area downstream (E. side of road) of source spring. None found at source spring on W. side of road (spring impacted by road building). Partly forested but heavily cut over in adjacent areas; some fire damage. 10/29/1995 TF, EJ! [B12]

163. [2305] Denny Creek-north spring runs at base. Zone 10: 581,000E 4,960,110N. Aspen Lake 1985 quad., Klamath Co. Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed springs in N. end of Denny Creek source area; lower combined runs just W. of Weyerhaeuser access road. Elev. 4270'. Depth 4-10". Large swift spring run; mud-cobble substrate; some logs; abundant *Myriophyllum*; common bryophytes; rare *Nostoc*; sedge meadow/forest border. Sphaeriids only, not retained (*Pisidium variabile*, and *Pisidium casertanum*). Collected by dip net. Heavily grazed. 10/29/1995 TF, EJ! [B12]

164. [2306] Denny Creek-middle spring run. Zone 10: 580,850E 4,689,570N. Aspen Lake 1985 quad., Klamath Co. Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed middle spring runs *ca.* 0.75 mi. NE of source and 0.1 mi. S. of Weyerhaeuser access road off (SW of) main access road. Elev. 4295'. Depth 0-4". Spring run with mud-cobble substrate; abundant logs; patches of bryophytes; no macrophytes. Sphaeriids only, not retained (*Pisidium*

insigne, *Pisidium casertanum*, and *Pisidium variabile*). Grazed heavily. 10/29/1995 TF, EJ! [B12]

165. [2307] Denny Creek-south most spring run in main set. Zone 10: 580,460E 4,688,850N. Aspen Lake 1985 quad., Klamath Co. Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. S.-most run in N. part of Denny Creek source area, examined just W. of Weyerhaeuser access road and *ca.* 0.3 mi. NE of origin. Elev. 4380'. Spring run now dry. No mollusks. Dry; badly cut over and grazed. 10/29/1995 TF, EJ! [B12]

166. [2308] Denny Creek south most spring. Zone 10: 580,640E 4,686,960N. Aspen Lake 1985 quad., Klamath Co. Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring *ca.* 1.7 mi. S. of rest of Denny Creek source area; collected in glade just W. of Weyerhaeuser access road. Elev. 4430'. Depth 0-3". Medium-large cold spring run; common *Myriophyllum*, *Mimulus*, *Rorippa*, local bryophytes; mud-cobble substrate; in forest to E.; open to W. Common sphaeriids and small *Fluminicola*; dip net and tray collections. Grazed W. of road and mostly logged; forest remnant to E. 10/29/1995 TF, EJ! [B13]

167. [2309] Aspen Lake northwest springs-1. Zone 10: 580,400E 4,685,290N. Aspen Lake 1985 quad., Klamath Co. Aspen Lake-Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed N.-most spring run on NW side of Aspen Lake, NW side of lower Weyerhaeuser access road. Elev. 4360'. Depth 0-3". Boggy spring run; abundant wood and leaves; grasses; no macrophytes; mud-cobble substrate; myrtle locally and bryophytes. No mollusks; dip net collection. Fire and logging. 10/29/1995 TF, EJ! [B13]

168. [2310] Aspen Lake northwest springs-2. Zone 10: 580,360E 4,685,100N. Aspen Lake 1985 quad., Klamath Co. Aspen Lake-Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed second spring run on NW side of Aspen Lake, *ca.* 0.1 mi. SE of 1st spring run and NW of Weyerhaeuser lower access road. Elev. 4350'. Depth 0-3". Boggy spring run; abundant wood and leaves; grasses; no macrophytes; mud-cobble substrate; myrtle locally and bryophytes. No mollusks; dip net collection attempted. Fire and logging. 10/29/1995 TF, EJ! [B13]

169. [2311] Aspen Lake northwest springs-3 (lower). Zone 10: 580,270E 4,684,860N. Aspen Lake 1985 quad., Klamath Co. Aspen Lake-Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed double spring run in boggy area on NW side of Weyerhaeuser lower access road, NW side of Aspen Lake; 3rd spring run from N. Elev. 4340'. Depth 0-6". Cold spring runs with abundant wood fragment and logs; mud and scattered cobble substrate; no macrophytes except local bryophytes and myrtle. Sphaeriids only (*Pisidium casertanum*); not retained. Fire and grazing, some logging damage. 10/29/1995 TF, EJ! [B13]

170. [2312] Aspen Lake northwest springs-3 (upper). Zone 10: 579,890E 4,685,160N. Aspen Lake 1985 quad., Klamath Co. Aspen Lake-Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Third spring run from N. in Aspen Lake NW group, collected below (SE of) Weyerhaeuser upper access road and below glade. Elev. 4410'. Depth 0-4". Cold spring with mud-cobble substrate; local myrtle, *Rorippa*. Uncommon *Pisidium casertanum* only; not retained. Dip net collected. Mostly logged recently. 10/29/1995 TF, EJ! [B13]

171. [2313] Aspen Lake northwest springs-4. Zone 10: 580,240E 4,684,250N. Aspen Lake 1985 quad., Klamath Co. Aspen Lake-Denny Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Fourth (S. most) spring run in NW Aspen Lake set, *ca.* 0.75 mi. S. of 1st, on Weyerhaeuser lower access road. Elev. 4320'. Depth 0-12". Cold spring with common logs, wood fragments; no macrophytes; mud-cobble substrate. No mollusks; dip net collection. Partly logged and grazed. 10/29/1995 TF, EJ! [B13]

172. [2317] Threemile Creek at Westside Road Bridge. Zone 10: 575,540E 4,721,520N. Mares Egg Spring 1985 quad., Klamath Co. Threemile Creek-Sevenmile Creek-Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Threemile Creek to W. of Westside Road Bridge, Winema National Forest. Elev. 4220'. Dry creek; cobble and sand substrate. No mollusks. 10/30/1995 TF, EJ! [B68]

173. [2318] Fourmile Creek at Cold Creek Road. Zone 10: 566,320E 4,699,330N. Lake of the Woods North 1985 quad., Klamath Co. Fourmile Creek-Klamath Lake-Link River-Lake Ewauna-Klamath River. Fourmile Creek to the W. of Cold Creek Road (FS 3651), Winema National Forest. Elev. 4470'. Depth 0-4". Small creek; cobble substrate; no macrophytes or epiphytic algae. Sphaeriids only, not retained. Collected by dip net. Looks good; but rare mollusks. 6/27/1994 TF, EJ! [B57]

174. [2319] Clover Creek at Spencer Creek Road Bridge. Zone 10: 576,450E 4,674,460N. Spencer Creek 1986 quad., Klamath Co. Clover Creek-Spencer Creek-Klamath River. Clover Creek below Spencer Creek Hook-up Road Bridge, *ca.* 0.15 mi. SW of junction with Clover Creek Road, BLM lands. Elev. 4020'. Dry creek; sand and cobble substrate. No mollusks. 10/30/1995 TF, EJ! [B87]

175. [2325] Unnamed Lost Creek Spring. Zone 10: 604,600E 4,776,950N. Sugarpine Mtn. NW 1968 quad., Klamath Co. Lost Creek. Unnamed spring about 4.8 rd. mi. E. of Diamond Junction off US 97 on FS 86, just S. of road, W. of Lost Creek Spring, Winema National Forest. Elev. 4850'. Depth 18-48". Small spring in valley of Lost Creek; pumice substrate; common epiphytic algae, *Ceratophyllum*, *Potamogeton crispus* locally. No mollusks; dip net collection attempted. 6/11/1994 TF, EJ! [B92]

176. [2326] Lost Creek Spring. Zone 10: 605,300E 4,777,005N. Sugarpine Mtn. NW 1968 quad., Klamath Co. Lost Creek. Lost Creek Spring at head of Lost Creek, about 5.2 rd. mi. E. of Diamond Lake Junction off US 97 on FS 86, just SE of road, Winema National Forest. Elev. 4940'. Depth 10-36". Small cold source spring; pumice substrate; common epiphytic algae; no macrophytes. No mollusks; dip net collection attempted. 6/11/1994 TF, EJ! [B92]

177. [2327] Unnamed spring west of Camp McLoughlin. Zone 10: 563,100E 4,691,680N. Lake of the Wood North 1985 quad., Klamath Co. Dry Creek-Lake Of The Woods-Seldom Creek-Fourmile Creek-Upper Klamath Lake-Link River-Ewauna-Klamath River. Unnamed spring at head of run on NW side of trail #3724, W. of FS 3640, 0.6 mi. W. of Camp McLoughlin, Winema National Forest. Elev. 4970'. Depth 0-3". Numerous small cold spring channels beneath tree roots; no macrophytes; no epiphytic algae; mixed gravel and sand; bryophytes common. No mollusks despite looking good. 6/27/1994 TF, EJ! [B58]

178. [2349] Unnamed spring in Klamath Falls. Zone 10: 601,460E 4,675,500N. Klamath Falls 1985 quad., Klamath Co. Lake Ewauna-Klamath River. Former unnamed spring in Southern Pacific Rail Yard in Klamath Falls (NE end of yard). Elev. 4100'. Spring essentially gone; grasses and short sedges. No mollusks. Fenced partially; spring now merely a green spot adjacent to tank farm (newly expanded); trashy area. 10/23/1995 TF, EJ! [B54]

179. [1976] Williamson River at FS 43 bridge. Zone 10: 595,520E 4,732,460N. W½ NW¼ NW¼ NE¼ SW¼ sec. 1, T33S R7E, Soloman Butte 1988 quad., Klamath Co. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Williamson River downstream of FS 43 bridge, SW of the site of Kirk, Winema National Forest. Elev. 4500'. Dry river bed with boulder (basalt) substrate; grasses. No mollusks. 6/11/1994 TF, EJ! [B86]

180. [2314] Fourmile Creek east of Westside Road. Zone 10: 572,800E 4,700,670N. SW¼ SW¼ SW¼ NE¼ NE¼ sec. 9, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Fourmile Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Fourmile Creek on E. side of Westside Road bridge, Winema National Forest. Elev. 4150'. Dry creek. No mollusks. 6/27/1994 TF, EJ! [B78]

181. [2197] Agency Lake at Henzel Park. Zone 10: 588,000E 4,708,940N. NE¼ NE¼ NW¼ NE¼ NW¼ sec. 19, T35S R7E, Agency Lake 1985 quad., Klamath Co. Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Agency Lake near boat ramp in Henzel County Park. Elev. 4141'. Depth 1-5'. Lake with silt bottom; no macrophytes. No mollusks found. 8/15/1991 TF, EJ, JJ! [B4] 4212158

182. [2198] Snake Creek unnamed spring 4. Zone 10: 642,850E 4,706,670N. SW¼ NE¼ SE¼ SE¼ SW¼ sec. 26, T35S R17E, Spodue Mtn. 1988 quad., Klamath Co. Snake Creek-Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring in pasture over 0.1 mi. S. of Snake Creek and 0.1 mi. E. of Godowa Springs Road (Klamath County 1193). Elev. 4349'. Depth 1-2". Spring with mud substrate; no macrophytes. No mollusks. 10/22/1995 TF, EJ! [B89]

183. [2389] Gwinn Spring Creek at Gwinn Spring Creek Road. Zone 10: 669,580E 4,652,240N. Antler Point 1988 quad., Klamath Co. Gwinn Spring Creek-Rock Creek-Lost River-Lower Klamath Lake. Gwinn Spring Creek above (E. of) crossing of Gwinn Spring Creek Road (BLM 6188). Elev. 4905'. Depth 0-6". Small cold spring creek; abundant *Rorippa*, local *Veronica* and *Potamogeton filiformis*. Somewhat abundant *Fluminicola* hand and dip net collected. 10/26/1995 TF, EJ! [B8]

184. [1996] Unnamed spring east of Odessa Creek. Zone 10: 577,030E 4,697,590N. NW¼ SW¼ SE¼ NE¼ NW¼ sec. 24, T36S R6E, Pelican Bay 1985 quad., Klamath Co. Odessa Creek-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring *ca.* 0.13 mi. E. of Odessa Spring on S. side of Odessa Creek, inholding in Winema National Forest. Elev. 4150'. Depth 0-6". Large cold spring with cobble-boulder bottom; no macrophytes. No mollusks. Formerly impounded by concrete dam near mouth of spring. 6/25/1994 TF, EJ! [B79]

185. [1420] Unnamed Spring northwest of Beatty. Zone 10: 638,920E 4,703,320N. SE¼ SE¼ SE¼ SE¼ SE¼ sec. 5, T36S R12E, Beatty 1988 quad., Klamath Co. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Unnamed spring 2.7 rd. mi. W. of Godowa Springs Road along Drews Road on N. side, NW of Beatty. Elev. 4290'. Former spring now dry. No mollusks. Spring pumped dry. 10/22/1995 TF, EJ! [B15]

186. [1471] Unnamed Spring east of Whiskey Creek. Zone 10: 635,020E 4,694,980N. NE¼ SE¼ NE¼ NE¼ NW¼ sec. 1, T37S R11E, Beatty 1988 quad., Klamath Co. Whiskey Creek-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring on S. side of OR 140 just E. of crossing of Whiskey Creek. Elev. 4355'. Former spring now dry. No mollusks. 6/21/1994 TF, EJ! [B16]

187. Fifth Link River spring. Zone 10: 599,535E 4,674,920N. NE¼ SW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Fifth spring from the south on west side of Link River at about RM 253.5, north of USGS gauging station, west of Klamath Falls. Elev. 4890'. Depth 1-3". Cold spring formerly with abundant *Rorippa*. Mud-sand bottom with some cobbles. Cold spring now with abundant *Rorippa*. Mud-sand bottom with some cobbles and wood debris. Spring not shown on USGS map. 7 springs total in the area, with 4 small springs south and 3 large springs north of USGS gauging station.

Juga recently dead only; hand collected. Spring impacted by people gathering *Rorippa*. 08/15/1991 TF, EJ, JJ! No *Juga* shells seen, probably extinct now. 10/26/1992 TF, EJ, JJ! Abundant *Juga* and small *Pyrgulopsis*. Collected by hand and tray. 10/01/1997 TF, EJ! [B54]

188. [1482] Unnamed spring at Klamath River RM 212.7. Zone 10: 571,560E 4,652,740N. SW¼ SW¼ SE¼ SW¼ SE¼ sec. 5, T41S R6E, Mule Hill 1985 quad., Klamath Co., Oregon. Klamath R. Unnamed spring run on Klamath Rim above heavily grazed flat (former fen), N. of Klamath River (RM 212.7), BLM lands. Elev. 3450'. Depth 1.0-2.0". Small cold spring with mud substrate. No macrophytes. No mollusks. Spring heavily impacted by cattle grazing. 8/16/1991 TF, EJ, JJ! [B74]

189. [3056] Ditch east of northeast end of Hanks Marsh. Zone 10: 597,440E 4,686,900N. NE¼ NE¼ NW¼ NE¼ NE¼ sec. 25, T37N R8E, Wocus 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Drainage ditch between BN-SPRR track and US97, east of NE end of Hank Marsh, about 0.1 mi. north of junction of Shady Pine Road, Upper Klamath National Wildlife Refuge. Elev. 4143'. Depth 1-3". Small channel with mud and some loose basalt pebbles-cobbles; local *Potamogeton crispus*; some epiphytic algae. Common *Vorticifex*; *Valvata humeralis*; rare *Fluminicola*; rare sphaeriids. Hand collected. Flows away from lake. 09/28/1997 TF, EJ! [B97]

190. [3057] Upper Klamath Lake at northeast end of Hanks Marsh. Zone 10: 597,420E 4,686,900N. NE¼ NE¼ NW¼ NE¼ NE¼ sec. 25, T37N R8E, Wocus 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Upper Klamath Lake at NE end of Hanks Marsh and Upper Klamath National Wildlife Refuge, west of BN-SPRR track and US97 (The Dalles California Highway), about 0.1 mi. north of Shady Pine Road junction. Elev. 4143'. Depth 1-4'. Lake with scattered large boulders, cobbles on peat substrate and mud; partly exhumed old potholed *Typha* bog; no macrophytes; some epiphytic algae near shore; abundant organic debris. Common *Pyrgulopsis archimedis*, *Fluminicola*; *Vorticifex*; sphaeriids; uncommon *Pisidium ultramontanum*; uncommon *Physella*. Dip net collected. 09/28/1997 TF, EJ! [B97]

191. [3058] Barkley Spring channel just north of US97 bridge. Zone 10: 597,750E 4,692,740N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lk.-Link R.-Lk. Ewauna-Klamath R. Barkley Spring dredged channel between BN-SPRR track and US97 (The Dalles California Highway), just N. of US97 bridge over channel. Elev. 4143'. Depth 1-4'. Channel with mostly mud and silt (local gravel and boulders, mostly near shore); *Ceratophyllum*; *Elodea*; common epiphytic algae, some mats. Rapid drop-off to pure mud (several feet thick). Rare *Carinifex*; common *Fluminicola*; *Physella*; common sphaeriids, mostly small. Dip net collected. 9/28/1997 TF, EJ! [B72]

192. [3059] Barkley Spring channel west of US97 bridge. Zone 10: 597,730E 4,692,700N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Barkley Spring dredged channel on west side of US97 bridge, between BN-SPRR track and US97 (The Dalles California Highway). Elev. 4143'. Depth 1-4'. Channel with mostly mud and silt; some scattered near shore gravel and rare cobbles (basalt) throughout; abundant macrophytes (*Potamogeton crispus*, *Myriophyllum*, some *Elodea*), epiphytic algal mats; abundant wood fragments in most areas. Rapid drop-off. Common small *Fluminicola*; *Planorbella*; *Stagnicola caperata*; *Physella*; uncommon *Radix*; uncommon sphaeriids, *Gyraulus*. Dip net collected. 09/28/1997 TF, EJ! [B72]

193. [3060] Barkley Spring channel east of US97 bridge. Zone 10: 597,790E 4,692,690N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Barkley Spring dredged channel on east side of US97 (The Dalles California Highway) bridge, Hagelstein County Park. Elev. 4143'.

Depth 1-3'. Channel with mostly mud and silt; some scattered near shore gravel and rare cobbles (basalt) throughout; abundant macrophytes (*Potamogeton crispus*, *Ceratophyllum*, some *Elodea*; rare *Azolla*), epiphytic algal mats; abundant wood fragments in most areas. Rapid drop-off. Common *Planorbella*; *Stagnicola caperata*; rare *Lymnaea stagnalis appressa*; *Valvata humeralis*; *Carinifex*; common *Physella*; rarer *Fluminicola*, *Vorticifex*; common sphaeriids including *Pisidium idahoense*. Dip net collected. 09/28/1997 TF, EJ! [B72]

194. [3061] Spring west of Old Fort Road. Zone 10: 603,460E 4,681,240N. NE¼ SW¼ NW¼ NW¼ SE¼ sec. 10, T37S R9E, Whiteline Reservoir 1985 quad., Klamath Co., Oregon. Plum Valley-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring west of Old Fort Road and Hogback Mountain. Elev. 4550'. Dry spring. No mollusks. 09/28/1997 TF, EJ! [B95]

195. [3062] Hagelstein North Springs: northwest of bridge. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. At to 100' north of NW side of wooden foot bridge in north spring set, Hagelstein County Park. Depth 4-48". Spring pool with boulders and cobble near shore; gravel-mud offshore; abundant *Elodea*, *Ceratophyllum*, *Potamogeton crispus*; some epiphytic algae, including mats. *Lanx* and *Vorticifex klamathensis sinitsini* nearshore; Common *Fluminicola*, *Carinifex*, sphaeriids off shore. Dip net collected. 09/29/1997 TF, EJ! [B72]

196. [3063] Hagelstein North Springs: southwest of bridge. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. SW side of wooden foot bridge on north spring set in Hagelstein County Park and 100' SE. Depth 4-48". Spring pool with nearshore boulders and cobble; offshore mud, silt, local gravel; dense macrophyte beds; mostly *Elodea* and *Potamogeton crispus*; some *Ceratophyllum*; rare 2nd *Elodea* sp.: abundant algae including some local mats. Common Carinifex and *Fluminicola* offshore; *Vorticifex klamathensis sinitsini* nearshore (few *Fluminicola*, no *Lanx*); uncommon sphaeriids offshore. 09/29/1997 TF, EJ! [B72]

197. [3064] Hagelstein North Springs: below bridge and to south. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park, north springs, between wooden bridge and south-most, on east side. Depth 4-36". Spring pool with mostly mud and silt bottom; abundant plant fragments; common *Elodea*, some *Potamogeton crispus*; abundant epiphytic algae, including mats. Some open water areas or with sparse *Elodea*. Abundant *Carinifex*; common *Valvata humeralis* and *Stagnicola caperata*; uncommon small sphaeriids; common *Physella*; rare or no live *Vorticifex* and *Fluminicola*. 09/28/1997 TF, EJ! [B72]

198. [3065] Hagelstein North Springs: south-most near siphon. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park; north spring set, south-most spring, south pool with siphon. Depth 4-42". Spring pool with rocks and cobbles nearshore and near siphon; otherwise mostly silt and mud; abundant *Potamogeton crispus*, *Ceratophyllum* nearshore; *Elodea* offshore; common epiphytic algae. Abundant *Carinifex*, common *Valvata humeralis*, *Stagnicola*, *Physella*; rare sphaeriids, uncommon *Fluminicola*, *Vorticifex*. Dip net collected. 09/29/1997 TF, EJ! [B72]

199. [3066] Hagelstein North Springs: south-most center. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park; north set springs, south-most springs, south-most spring near center. Depth 8-48". Spring pool with rocks nearshore; mostly mud offshore; abundant macrophytes (*Potamogeton crispus*, *Elodea*; *Ceratophyllum*);

some open area with *Elodea* only; uncommon epiphytic algae. Common large *Carinifex*; *Fluminicola*; uncommon *Vorticifex*; *Stagnicola caperata*; small sphaeriids. Dip net collected. 09/29/1997 TF, EJ! [B72]

200. [3067] Hagelstein main channel: east side center. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park main channel east side center. Depth 12-40'. Channel with mostly mud and fine pumice gravel; abundant epiphytic algae, some mats; some open areas with low *Elodea*; some emergent plants; abundant *Potamogeton crispus* and *Elodea* in some areas. Common *Carinifex*, *Stagnicola caperata*; *Radix*, *Physella*; uncommon sphaeriids, some large; common *Valvata humeralis*, *Lymnaea stagnalis appressa*. Dip net collected. 09/29/1997 TF, EJ! [B72]

201. [3068] Hagelstein: Barkley Spring run at fish diversion. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park-Barkley Spring channel, west part (north side) near junction with irrigation channel. Depth 1-4". Spring run with mostly mud-silt; mostly open or small *Elodea*; local small cobbles-gravel; frequently covered with *Typha* segments and other plant debris. Rare *Vorticifex*, *Fluminicola*; abundant *Stagnicola caperata*, *Physella*; uncommon sphaeriids; uncommon live Carinifex. Dip net collected. 09/29/1997 TF, EJ! [B72]

202. [3069] Hagelstein North Springs: southeast side of north-most. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. SE side of north most spring pond, north set of Hagelstein County Park springs. Depth 2-60". Spring pond with boulders nearshore; mud and silt offshore; abundant macrophytes (*Myriophyllum*, *Ceratophyllum*, *Elodea*); minor epiphytic algae; deep spring pond. *Lanx*, *Vorticifex klamathensis sinitsini*, and rare *Lyogyrus* on rocks; *Fluminicola* and *Carinifex* common offshore; may be nodose *Lyogyrus*. 09/30/1997 TF, EJ! [B72]

203. [3070] Hagelstein North Springs: east side of neck. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. East side of neck between north-most of north springs and second bay, Hagelstein County Park. Depth 6-34". Rare boulders and cobbles nearshore; gravel slightly offshore, mud central; dense macrophytes (*Elodea*, some 2nd *Elodea* sp., *Potamogeton crispus*, *Myriophyllum*); some uncommon epiphytic algae; some branches and sticks. Common large *Lanx*, large *Vorticifex klamathensis sinitsini*; some sphaeriids, common *Physella*, and *Fluminicola*. Dip net collected. Many large dead *Lanx* and *Vorticifex klamathensis sinitsini* in sediment. Dead *Carinifex* only. 09/30/1997 TF, EJ! [B72]

204. [3071] Hagelstein North Springs: west side of neck. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. West side of neck between north-most of north springs and second bay, Hagelstein County Park. Depth 12-24". Mostly rocky (cobble-boulder) with silt patches; macrophytes minor, offshore (Myriophyllum); epiphytic algae nearshore and offshore rocks. Common *Vorticifex klamathensis sinitsini*; less common *Fluminicola* and *Lanx*; rare *Lyogyrus* (sporadic); no/minor sphaeriids; rare *Physella*. Dead *Carinifex* only in sediment. Dip net collected. 09/30/1997 TF, EJ! [B72]

205. [3072] Hagelstein North Springs: northeast of bridge. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park-north spring set; NE of bridge. Depth 7-16". Spring pool; rocky on shore; mostly mud, part near anoxic (most OK);

abundant *Potamogeton crispus* and *Elodea*; sporadic epiphytic algae. Very common large *Carinifex*, common *Valvata humeralis*, uncommon sphaeriids, *Physella, Vorticifex klamathensis sinitsini*, and *Fluminicola*. Dip net collected. 09/30/1997 TF, EJ! [B72]

206. [3073] Hagelstein North Springs: west side south of bridge. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Hagelstein County Park-west side between bridge and south-most bays. Depth 12-48". Spring pool with deep mud and rare gravel offshore; boulders and cobbles nearshore; dense macrophytes (*Potamogeton crispus*, *Elodea*, abundant epiphytic algae, including floating mats; *Lemna* nearshore. Very common *Carinifex*; less common *Vorticifex* uncommon-rare *Fluminicola*; very rare *Lanx*; uncommon small sphaeriids; uncommon *Physella*. Few mollusks on nearshore rocks. Dip net collected. 09/30/1997 TF, EJ! [B72]

207.[3074] Hagelstein: ditch south of Barkley Spring. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Narrow ditch at extreme SE corner of Hagelstein County Park, south of irrigation channel. Depth 1-4". Narrow rocky ditch with patches of silt; no macrophytes; uncommon epiphytic algae. *Fluminicola*; some *Vorticifex klamathensis sinitsini*; 1 *Lanx*; *Physella*; abundant dead *Carinifex*. Hand collected. 09/30/1997 TF, EJ! [B72]

208. [3075] Hagelstein: north side of south irrigation channel. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. East side of south-most (irrigation) channel, just south of Hagelstein County Park. Depth 8-40". Channel with mostly mud and silt substrate; some pumice gravel; very dense macrophytes (mostly *Potamogeton crispus* and *Elodea*); abundant epiphytic algae, including floating mats; abundant *Lemna minor*. Abundant *Carinifex* and sphaeriids, including large specimens; rarer *Fluminicola* and *Vorticifex*; common *Physella*, *Stagnicola*, uncommon *Planorbella*, *Lymnaea stagnalis appressa* and *Radix*. Dip net collected. 09/30/1997 TF, EJ! [B72]

209. [3077] Hagelstein: midpoint of west outlet channel. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. About midpoint on east side of west-side channel adjacent to Hagelstein County Park between BN-SPRR tracks and US97. Depth 1-4'. Mud-peat bottom channel; small *Elodea* in open areas; offshore dense *Potamogeton crispus*; abundant plant fragments; anoxic smell locally. Uncommon *Fluminicola* and abundant small sphaeriids, *Carinifex*; uncommon *Physella*; uncommon *Valvata humeralis* and *Vorticifex*. Dip net collected. 09/30/1997 TF, EJ! [B72]

210. [3078] Hagelstein: east side, north 1/3 of west outlet channel. Zone 10: Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Depth 1-4'. Channel with thick mud substrate; dense offshore *Potamogeton crispus*; short *Elodea* and rather open nearshore; some epiphytic algae. Rare *Valvata humeralis*; common small sphaeriids; common *Fluminicola* and *Vorticifex*; uncommon *Physella* and *Stagnicola*. One small *Anodonta*. Dip net collected. 09/30/1997 TF, EJ! [B72]

211. [3079] Link River at RM 253.4. Zone 10: 599,595E 4,674,830N. SE¼ SW¼ SE¼ SE¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Link River on west side, north of flume outlet and east of *Typha* Marsh, RM 253.4. Elev. 4086'. Depth 12-28". Basalt bedrock lined river with some boulders and cobbles, many cemented; no macrophytes; abundant epiphytic algae; uncommon sponges and bryozoans. Rare *Lanx klamathensis*; *Vorticifex*. Hand and dip net collected. 10/01/1997 TF, EJ! [B54]

212. [3080] First Link River spring. Zone 10: 599,570E 4,674,918N. NW¼ SE¼ SW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. south-most spring run just south of USGS gauging station, west side of Link River at RM 253.5, Klamath Falls. Elev. 4087'. Depth 1-2". Very small somewhat warm spring run; muddy, with abundant woody debris; *Salix* and *Alnus* leaves;, scattered gravel and rare cobbles. Spring not shown on USGS map. 7 springs total in the area, with 4 small springs south and 3 large springs north of USGS gauging station. Common *Pyrgulopsis* hand collected. 10/01/1997 TF, EJ! [B54]

213. [3081] Second Link River spring. Zone 10: 599,565E 4,674,920N. NW¼ SE¼ SW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Second spring run from south about 6' from south-most spring run, just south of USGS gauging station, west side of Link River at RM 253.5, Klamath Falls. Elev. 4087'. Depth 0-1". Very small somewhat warm spring run; muddy with minor gravel and cobbles; abundant wood fragments, no macrophytes or epiphytic algae; *Cornus*, *Salix*, and *Alnus* leaves in channel. Source emerging from base of a tree. Spring not shown on USGS map. 7 springs total in the area, with 4 small springs south and 3 large springs north of USGS gauging station. Uncommon medium sized *Pyrgulopsis*. Hand collected. 10/01/1997 TF, EJ! [B54]

214. [3082] Sixth Link River spring. Zone 10: 599,520E 4,674,920N. SE¼ NW¼ SW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Sixth spring run from south, north of USGS gauging station, west side of Link River at RM 253.5, Klamath Falls. Elev. 4088'. Depth 1-4". Medium-sized spring run with abundant *Rorippa*; no epiphytic algae; gravel, cobbles, some extensive mud; common wood fragments. Spring not shown on USGS map. 7 springs total in the area, with 4 small springs south and 3 large springs north of USGS gauging station. Common *Juga* (*Oreobasis*); abundant small *Pyrgulopsis* n. sp. Dip net and tray collected. 10/01/1997 TF, EJ! [B54]

215. [3084] Seventh Link River spring. Zone 10: 599,515E 4,674,990N. SE¼ NW¼ SW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Seventh spring run from south (north-most spring run), north of USGS gauging station, west side of Link River at about RM 253.5, Klamath Falls. Elev. 4088'. Depth 1-4". Moderate-sized spring run; mud with extensive gravel-cobble patches; patchy *Rorippa* and rarer Oregon myrtle. Spring not shown on USGS map. 7 springs total in the area, with 4 small springs south and 3 large springs north of USGS gauging station. Common *Juga*; abundant small *Pyrgulopsis* n. sp. Collected by dip net and tray. 10/01/1997 TF, EJ! [B54]

216. [3169] Link River side channel at RM 253.6. Zone 10: 599,465E 4,675,090N. SW¼ SW¼ NW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Link River sided channel on west side at RM 253.6, Klamath Falls. Elev. 4088'. Depth 1-3'. River side channel with mud-boulder substrate; east side a small island completely covered by *Typha*. Channel and island not shown on USGS map. *Valvata humeralis* and *Vorticifex* collected by hand and dip net. 10/01/1997 TF, EJ! [B54]

217. [2320] Link River at RM 253.6. Zone 10: 599,475E 4,675,100N. SW¼ SW¼ NW¼ SW¼ NW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. West side of Link River at RM 253.6, east side of small island, Klamath Falls. Elev. 4088'. Depth 1-4'. Mud bottomed river with occasional cobbles-boulders; east side of small island completely covered by *Typha*. Island not shown on USGS map. *Vorticifex* collected by hand and dip net. 10/01/1997 TF, EJ! [B54]

218. [3085] Link River at Veterans Memorial City Park. Zone 10: 600,000E 4,674,620N. NE¼ NE¼ SW¼ NE¼ SW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Above Lake Ewauna at mouth of Link River, RM 253.1, NE side of river near west entrance to Veterans Memorial City Park, under and east of US97/OR140 bridge, Klamath Falls. Elev. 4086'. Depth 1-4'. River with cobble-boulder (basalt) lined bank; somewhat rapid drop-off; rather dense common short epiphytic algae on rocks; no macrophytes. Moderately common *Fluminicola*, *Vorticifex*; less common *Lanx* and *Lyogyrus* on rocks (*Lyogyrus* on undersides of rocks only). Collected by tray and brush. 10/02/1997 TF, EJ! [B54]

219. [3086] Link River below Link River Dam. Zone 10: 599,150E 4,675,920N. NW¼ SE¼ NW¼ SE¼ SE¼ sec. 30, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Link River on east side, upper part of Klamath Falls below Link River Dam, RM 254.2, City of Klamath Falls. Elev. 4110'. Depth 2-4'. River with basalt bedrock substrate; no macrophytes; rapids. Very rare *Physella* hand collected. 10/02/1997 TF, EJ! [B54]

220. [3087] Link River above Link River Dam. Zone 10: 598,840E 4,676,420N. NE¼ NW¼ NE¼ NW¼ SE¼ sec. 30, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Link River about 0.1 mi. above Link River Dam on east side, about RM 254.6, Klamath Falls. Elev. 4143'. Depth 1-4'. Pooled river with basalt bedrock substrate covered by mud; rare cobbles; *Typha* marsh along the shoreline. Rare *Vorticifex* and *Fluminicola* collected by hand and dip net. 10/02/1997 TF, EJ! [B54]

221. [3088] Link River downstream of A Canal intake. Zone 10: 598,780E 4,676,700N. SE¼ SE¼ NW¼ SW¼ NE¼ sec. 30, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Link River on east side downstream of intake of A Canal at RM 254.8, Klamath Falls. Elev. 4143'. Depth 1-3'. Pooled river with a substrate of mud and abundant wood debris; no macrophytes. *Vorticifex* dead only. Collected by dip net. 10/02/1997 TF, EJ! [B54]

222. [3089] Upper Klamath Lake at Moore City Park. Zone 10: 598,420E 4,676,480N. SW¼ SW¼ SE¼ SE¼ NW¼ sec. 30, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. south end of Upper Klamath Lake, west of Lakeshore Drive at NE corner of Moore City Park, just north of boat ramp. Elev. 4143'. Depth 1-3'. Lake with mud bottom offshore and mostly cobble-boulder substrate nearshore; *Typha* along the shoreline. Rare *Promenetus*, *Gyraulus*, *Planorbella*, and *Valvata humeralis* collected by hand. 10/02/1997 TF, EJ! [B54]

223. [3091] Link River opposite Veterans Memorial City Park. Zone 10: 599,990E 4,674,520N. SE¼ NE¼ SW¼ NE¼ SW¼ sec. 32, T38S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Link River-Lake Ewauna-Klamath River. Above Lake Ewauna on SW side of mouth of Link River, opposite Veterans Memorial City Park under US97/OR140 bridge, near sewage pumping station at about RM 253.1, Klamath Falls. Elev. 4086'. Depth 2-48". River with cobble-boulder lined bank; abrupt drop-off; rather dense common short epiphytic algae on rocks; no macrophytes. Very dense mollusks population on rocks. Mainly *Fluminicola*, *Vorticifex*, *Lanx*; common *Lyogyrus* on undersides of rocks. Collected by hand and tray and brush. 10/02/1997 TF, EJ! [B54]

224. [3092] Spring southwest of US97 Klamath River Bridge. Zone 10: 599,010E 4,669,820N. NW¼ SE¼ NE¼ NW¼ SE¼ sec. 18, T39S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Klamath River. Unnamed spring on west side of Klamath River at RM 248.95, SW of US97 bridge, east of West Klamath. Elev. 4100'. Dry spring. No mollusks. 10/02/1997 TF, EJ! [B55]

225. [3093] Klamath River at US97 Bridge. Zone 10: 599,205E 4,669,880N. Center NW¼ NE¼ SE¼ sec. 18, T39S R9E, Klamath Falls 1985 quad., Klamath Co., Oregon. Klamath River. Klamath

River on west side at RM 249.0, SW of US97 bridge, east of West Klamath. Elev. 4085'. Depth 2-15". River with occasional cobbles on a mud bottom; no macrophytes. No mollusks. 10/02/1997 TF, EJ! [B55]

226. [3094] Spring Lake. Zone 10: 604,470E 4,661,000N. NE¼ SE¼ NE¼ NE¼ NE¼ sec. 15, T40S R9E, Lost River 1986 quad., Klamath Co., Oregon. Spring Lake-C Canal-Lost River-Lower Klamath Lake, Spring Lake Valley. Spring Lake at east side center, west of Spring Lake Road. Elev. 4070'. Depth 1-6". Lake with mud substrate; *Typha* marsh; pink algae on shore; H_2S smell. *Gyraulus* and *Radix* not retained. 10/03/1997 TF, EJ! [B64]

227. [3095] Lost River at Crystal Springs Road Bridge. Zone 10: 610,520E 4,667,630N. E½ NW¼ NW¼ NE¼ NE¼ sec. 29, T39S R10E, Altamont 1985 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake Lost River at RM 8.85 (Wilson Reservoir) on SW side of Crystal Springs Road bridge off Crystal Springs County Park. Elev. 4090'. Depth 28-46". River with mud and gravel with scattered cobbles; partly impounded; dense macrophytes (*Ceratophyllum*, *Potamogeton crispus*, some *Elodea*); some epiphytic algae, including floating mats; common *Lemna minor*. Common *Valvata humeralis*, *Planorbella*, *Fluminicola*; some *Radix*; *Physella*, large and small sphaeriids; rare *Vorticifex*; very rare *Pyrgulopsis* n. sp. 10/03/1997 TF, EJ! [B7]

228. [3096] Unnamed spring in Stevenson County Park. Zone 10: 615,730E 4,670,780N. NE¼ NW¼ SW¼ NW¼ NW¼ sec. 13, T39S R10E, Dairy 1985 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake, Poe Valley. Small springs on SW side of Stevenson County Park, SE of OR140. Elev. 4098'. Depth 0-1". Small somewhat warm springs; partly cased; *Rorippa* cover; common plant fragments; mud substrate. Springs not shown on USGS maps. Common *Stagnicola* dip net collected. 10/03/1997 TF, EJ! [B35]

229. [3097] Lost River at Stevenson County Park. Zone 10: 615,775E 4,670,800N. SW¼ SE¼ NW¼ NW¼ NW¼ sec. 13, T39S R10E, Dairy 1985 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake, Poe Valley. Lost River at Stevenson County Park, SE of OR140. Elev. 4095'. Depth 48-60". River with mostly mud substrate; scattered gravel and cobbles; dense macrophytes (*Ceratophyllum*, *Potamogeton crispus*; *Lemna minor*), common epiphytic algae. Common *Valvata humeralis*; abundant *Fluminicola*; uncommon *Pyrgulopsis*, *Radix*. Dip net and tray collected. Collected after a rainstorm. 10/03/1997 TF, EJ! [B35]

230. [3098] Olene Hot Springs. Zone 10: 614,180E 4,669,760N. NW¼ NE¼ NW¼ SW¼ SW¼ sec. 14, T39S R10E, Dairy 1985 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake. Olene Hot Springs above Lost River and OR140 (NW of), east of the site of Olene at The Gap. Elev. 4100'. Depth 0-1". Warm springs with mud substrate; *Typha*; Oregon myrtle. Position of springs shown incorrectly on USGS map. No mollusks. Springs modified at source (remnants of concrete foundation). 10/03/1997 TF, EJ! [B35]

231. [3099] Anderson Creek southeast of Twomile Ridge. Zone 10: 606,020E 4,687,660N. NE¼ SW¼ NE¼ NW¼ SW¼ sec. 24, T37S R9E, Whiteline Reservoir 1985 quad., Klamath Co., Oregon. Anderson Creek-Swan Lake. Anderson Creek below (south of) Swan Lake Road and SE of Whiteline Reservoir and Twomile Ridge. Elev. 4290'. Depth 1-3". Creek with mostly basalt cobble substrate; some mud patches; no macrophytes; very minor epiphytic algae. *Radix*, *Stagnicola caperata*; rare *Gyraulus* collected by hand. Creek impacted by grazing. 10/03/1997 TF, EJ! [B96]

232. [3100] Lost River below Harpold Dam. Zone 10: 627,840E 4,669,600N. SW¼ SE¼ SE¼ NW¼ SE¼ sec. 19, T39S R11E, Bonanza 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake Lost River between bridge and Harpold Dam. Elev. 4100'. Depth 0-48". River with mud -covered cobbles and mud patches; local dense macrophytes (*Potamogeton crispus*); local

Rorippa; abundant *Lemna minor* locally; common *Azolla* locally; abundant epiphytic algae. Abundant *Fluminicola*; moderately common *Pyrgulopsis*; *Physella*, *Stagnicola*; *Radix* (no *Valvata*). Collected by dip net and tray. Collected after rain storm. 10/03/1997 TF, EJ! [B19]

233. [3101] Lost River at bridge of Cheese Factory Road. Zone 10: 642,800E 4,663,780N. NW¼ NW¼ NE¼ NE¼ SE¼ sec. 10, T40S R13E, Bryant Mountain 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake, Langell Valley. Lost River below west side of bridge of Cheese Factory Road, east of Hot Springs. Elev. 4115'. Depth 6-30". River with minor gravel (rocks under bridge); dense *Ceratophyllum* locally; also some epiphytic algae. Common large sphaeriids; also *Radix*, *Physella*, *Gyraulus* collected by dip net and tray. River likely bridged but not channelized. Collected after storm. 10/04/1997 TF, EJ! [B23]

234. [3102] Lost River at bridge of Gift Road. Zone 10: 645,340E 4,661,400N. NE¼ NW¼ NE¼ NE¼ NW¼ sec. 24, T40S R13E, Langell Valley 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake, Langell Valley. Lost River on SW side of bridge of Gift Road. Elev. 4115'. Depth 6-30". Channelized river with mostly mud; local cobble and gravel; dense *Ceratophyllum* locally; odd broad-leaved macrophyte present; some epiphytic algae. Common *Planorbella*; rarer *Physella*, *Gyraulus*, *Valvata humeralis*, ?*Promenetus*, sphaeriids, and *Stagnicola* collected by dip net and tray. Collected after storm. 10/04/1997 TF, EJ! [B62]

235. [3103] Lost River at bridge of Johnson Road. Zone 10: 646,400E 4,656,580N. NW¼ NW¼ NW¼ NW¼ NW¼ sec. 6, T41S R14E, Langell Valley 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake, Langell Valley. Lost River at SE side of bridge of Johnson Road. Elev. 4115'. Depth 8-36". Channelized river with mostly mud; scattered gravel; dense *Ceratophyllum* locally; abundant *Lemna* locally; fairly dense epiphytic algae including floating mats. Sparse *Radix*; *Physella*; small sphaeriids; *Gyraulus*; *Stagnicola*; *Planorbella*. Collected by dip net and tray. Collected after a storm. 10/14/1997 TF, EJ! [B63]

236. [3104] Lost River below Malone Dam. Zone 10: 647,150E 4,651,900N. SW¼ NE¼ SE¼ SE¼ SW¼ sec. 18, T41S R14E, Langell Valley 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake Lost River about 200-400' below Malone Dam on north side and below bridge at junction of East and West Langell Valley Road, east of Langell Valley. Elev. 4125'. Depth 5-15". Channelized river with substrate mostly cobbles; mud patches; *Typha*, rare *Elodea*, abundant epiphytic algae. *Stagnicola* only collected by dip net; not retained. Common drift shells. Collected after storm. 10/04/1997 TF, EJ! [B63]

237. [3105] Malone Reservoir. Zone 10: 647,170E 4,651,760N. NW¼ NE¼ NE¼ NE¼ NW¼ sec. 19, T41S R14E, Langell Valley 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake Malone Reservoir collected on west and east shore. Elev. 4140'. Depth 6-48". Reservoir with cobbles and gravel on east side; mud in center and west side; abundant epiphytic algae. Mostly hand collected; common *Stagnicola*, *Planorbella*; less common *Radix*, *Physella*, *Gyraulus*, *Valvata*, *Fossaria*; rare *Anodonta*; no sphaeriids. Common drift. 10/04/1997 TF, EJ! [B63]

238. [3106] Malone Reservoir on east side. Zone 10: 697,320E 4,651,740N. NW¼ NE¼ NW¼ NW¼ NE¼ sec. 19, T41S R14E, Langell Valley 1988 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake Marshy area on east side of Malone Reservoir. Elev. 4145'. Grass and sedge marsh with scattered pumice and basalt cobbles and boulders. Common *Fossaria*; rare *Oxyloma*. Collected by hand. 10/04/1997 TF, EJ! [B63]

239. [3107] Bug Spring. Zone 10: 668,395E 4,658,220N. SE¼ NE¼ NW¼ SW¼ NE¼ sec. 32, T40S R15E, Antler Point 1988 quad., Klamath Co., Oregon. Bear Valley Canyon-Antelope Creek-East Branch Lost River-Lost River-Lower Klamath Lake Bug Spring 0.5 mi. SW of Bear

Valley Reservoir, 0.1 mi. east of BLM 40-15E-17, BLM lands. Elev. 5250'. Dry spring. No mollusks. Spring capped. 10/04/1997 TF, EJ! [B9]

240. [3108] Unnamed spring southwest of Deer Spring. Zone 10: 667,280E 4,660,600N. NE¼ NE¼ NE¼ SE¼ SE¼ sec. 19, T40S R15E, Antler Point 1988 quad., Klamath Co., Oregon. Bear Valley Canyon-Antelope Creek-East Branch Lost River-Lost River-Lower Klamath Lake. Unnamed spring 0.25 mi. SW of Deer Spring, west of BLM road 40-15E-17, BLM lands. Elev. 5255'. Depth 0-1". Spring with cobble and mud substrate; dense epiphytic algae. No mollusks. Spring diverted to watering pond (dammed); badly grazed. 10/04/1997 TF, EJ! [B9]

241. [3109] Deer Spring. Zone 10: 667,500E 46,660,790N. SE¼ NE¼ SW¼ NW¼ SW¼ sec. 20, T40S R15E, Antler Point 1988 quad., Klamath Co., Oregon. Bear Valley Canyon-Antelope Creek-East Branch Lost River-Lost River-Lower Klamath Lake Deer Spring to west of BLM 40-15E-17, BLM lands. Elev. 5280'. Depth 1-3". Spring with mostly mud substrate; very rare *Rorippa*; some epiphytic algae. No mollusks. Spring partly capped and badly damaged from grazing. 10/04/1997 TF, EJ! [B9]

242. [3110] Willow Spring. Zone 10: 664,320E 4,665,320N. SE¼ NE¼ NE¼ SW¼ SW¼ sec. 1, T40S R14 ½E, Brady Butte 1988 quad., Klamath Co., Oregon. Wildhorse Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Willow Spring immediately to west of BLM 40-15E-17 and 0.1 mi. N of junction with BLM road, BLM lands. Elev. 5240'. Dry spring. Spring not shown on USGS map; shown on Winema National Forest map. No mollusks. 10/04/1997 TF, EJ! [B22]

243. [3111] Moonshine Spring. Zone 10: 664,430E 4,670,280N. NW¼ NW¼ NE¼ SE¼ SW¼ sec. 24, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co., Oregon. Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Moonshine Spring about 0.3 mi. west of BLM 41-15E-17 (Mainhaul Road) bridge, on north side of Barnes Creek, BLM lands. Elev. 5050'. Depth 0-2". Spring partly modified; dense *Rorippa*; basalt cobbles and mud substrate; steep gradient locally. Common *Fluminicola* n. sp. and *Pisidium insigne*; rarer *Fossaria*. Dip net and hand collected. 10/04/1997 TF, EJ! [B47]

244. [3112] Norcross Spring. Zone 10: 662,160E 4,673,130N. NW¼ SW¼ SW¼ SW¼ SW¼ sec. 11, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co., Oregon. Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Norcross Spring just north of BLM 39-14-15.0 about 1.1 mi. east of junction of BLM 41-14E-11 (CCC Road), BLM lands. Elev. 4910'. Depth 1-18". Spring modified into a watering trough; dense epiphytic algae; mud substrate at bottom of trough; common wood and plant fragments. Uncommon sphaeriids only. 10/04/1997 TF, EJ! [B46]

245. [3113] Caseview Spring. Zone 10: 661,460E 4,672,320N. NW¼ SE¼ SW¼ SW¼ NE¼ sec. 15, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co., Oregon. Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake. Caseview Spring 0.2 mi. south of BLM 39-14-15.0, about 0.5 mi. east of junction of BLM 41-14E-11 (CCC Road), BLM lands. Elev. 4935'. Spring modified into a watering trough. No mollusks. Capped and diverted. Badly grazed. 10/04/1997 TF, EJ! [B46]

246. [3114] J' Spring. Zone 10: 658,940E 4,676,615N. NW¼ SE¼ NW¼ NW¼ SW¼ sec. 33, T38S R14E, Gerber Reservoir 1988 quad., Klamath Co., Oregon. Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake J' Spring less than 0.1 mi. east (inside) of Fremont National Forest boundary and almost 0.2 mi. east of BLM 41-14E-11 (CCC Road). Elev. 5080'. Spring; substrate of mud with common cobbles. Spring unnamed on USGS map; named on Fremont National Forest map. No mollusks. Mostly capped at source; badly grazed. 10/04/1997 TF, EJ! [B45]

247. [3115] Pine Spring. Zone 10: 660,240E 4,683,400N. SE¼ NE¼ NE¼ NE¼ SE¼ sec. 9, T38S R14E, Horsefly Mountain 1988 quad., Klamath Co., Oregon. Pole Creek-Dry Boulder Creek-Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Pine Spring just west of FS3814, Fork slope of Horsefly Mountain, Fremont National Forest. Elev. 5190'. Depth 1-5". Small spring with mostly mud substrate; some epiphytic algae. No mollusks. Spring badly grazed. 10/04/1997 TF, EJ! [B50]

248. [3119] Lost River at bridge of Merrill Road. Zone 10: 616,010E 4,653,050N. NW¼ SW¼ NW¼ NW¼ NW¼ sec. 11, T41S R10E, Merrill 1986 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake. Lost River at RM 14.1 on NE side of bridge of Merrill Road, 0.15 mi. south of Merrill. Elev. 4050'. Depth 4-48". River with mostly mud substrate with lesser amounts of gravel; abundant macrophytes (*Ceratophyllum*, *Zannichellia*; lesser *Potamogeton crispus* and *Elodea*). Abundant *Pyrgulopsis*; *Valvata humeralis*; rare *Vorticifex* and *Fluminicola*; uncommon sphaeriids; common *Stagnicola*, *Physella*, *Planorbella*; rare *Anodonta*. Dip net collected. 10/05/1997 TF, EJ! [B70]

249. [3120] Lost River at bridge of OR39. Zone 10: 614,020E 4,654,680N. NW¼ NE¼ SW¼ SE¼ SE¼ sec. 34, T40S R10E, Merrill 1986 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake. Lost River at RM 11.9 on NE side of bridge of OR39, 1.5 mi. NW of Merrill. Elev. 4055'. Depth 8-48". River with some *Ceratophyllum* and *Elodea*; some epiphytic algae; abundant sponge and attached algae; substrate mud with cobbles and gravel. Uncommon *Pyrgulopsis*; very rare *Fluminicola*, small *Gonidea angulata*. Dip net collected. 10/05/1997 TF, EJ! [B70]

250. [3121] Lost River at Stukel Bridge. Zone 10: 610,800E 4,659,630N. SW¼ SW¼ SE¼ SE¼ SE¼ sec. 17, T40S R10E, Lost River 1986 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake. Lost River at RM 6.5 on SE end of bridge of Matney Way (Stukel Bridge). Elev. 4050'. Depth 6-12". River with mud and barely gravel substrate; *Typha*, *Elodea*, *Potamogeton crispus*; abundant epiphytic algae; some spring influence. Abundant sphaeriids, *Fluminicola*; rare *Vorticifex*; uncommon *Physella*, *Stagnicola*; common *Pyrgulopsis*. Collected by dip net. 10/05/1997 TF, EJ! [B65]

251. [3122] Lost River at bridge of Dehlinger Lane. Zone 10: 608,220E 4,662,800N. SE¼ SE¼ SW¼ SE¼ SW¼ sec. 6, T40S R10E, Lost River 1986 quad., Klamath Co., Oregon. Lost River-Lower Klamath Lake. Lost River on NW side of Dehlinger Lane bridge about 0.8 mi. west of Dehlinger. Elev. 4055'. Depth 6-48". River with mostly sand substrate; no macrophytes; minor wood, gravel, epiphytic algae. Uncommon *Gonidea angulata* shells; common sphaeriid shells. Dip net collected. 10/05/1997 TF, EJ! [B65]

252. [3123] Sycan River at Drews Road bridge. Zone 10: 641,590E 4,704,900N. NW¼ NW¼ NE¼ NW¼ NE¼ sec. 3, T36S R12E, Beatty 1988 quad., Klamath Co., Oregon. Sycan River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Sycan River on SE side of Drews Road bridge. Elev. 4312'. Depth 12-24". River with mostly mud with some cobble substrate; abundant *Elodea*; moderately common epiphytic algae. Common *Fluminicola*; some *Physella* and sphaeriids. Hand and dip net collected. 10/06/1997 TF, EJ! [B15]

253. [3124] Sprague River north of Beatty. Zone 10: 642,220E 4,702,100N. SE¼ SE¼ SE¼ NE¼ SE¼ sec. 10, T36S R12E, Beatty 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Sprague River on NW side of Godowa Springs Road bridge, about 1.3 rd. mi. North of OR140 (Klamath Falls-Lakeview Highway) junction and Beatty. Elev. 4306'. Depth 6-12". River with mostly mud

substrate; moderately common *Elodea*; minor epiphytic algae and sponges. Common *Fluminicola*, *Pyrgulopsis*; less common *Vorticifex*, *Valvata*, sphaeriids, *Physella*, *Gyraulus*. Collected with dip net. 10/06/1997 TF, EJ! [B15]

254. [3125] Sprague River at Beatty Gap. Zone 10: 645,030E 4,700,760N. SE¼ SE¼ NE¼ NW¼ SE¼ sec. 13, T36S R12E, Ferguson Mountain 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Sprague River at USGS gauging station, Klamath County fishing access at old bridge (mostly gone), just off (North of) OR140 (Klamath Falls-Lakeview Highway), Beatty Gap. Elev. 4310'. Depth 6-24". River with mud mostly; some sand, gravel, cobbles; abundant *Elodea*; some epiphytic algae. Common *Fluminicola* and large sphaeriids; uncommon *Pyrgulopsis*, *Vorticifex*, *Physella*. Dip net collected. 10/06/1997 TF, EJ! [B37]

255. [3126] North Fork Sprague River at Campbell Road bridge. Zone 10: 655,270E 4,701,940N. NE¼ NE¼ NW¼ NW¼ NW¼ sec. 18, T36S R14E, Bly 1988 quad., Klamath Co., Oregon. North Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. North Fork Sprague River on SE side of Campbell Road bridge. Elev. 4325'. Depth 2-16". River with cobble substrate with sand and rare mud patches; rare *Elodea*; moderate epiphytic algae. No mollusks. 10/06/1997 TF, EJ! [B17]

256. [3127] Unnamed spring in Lower Fishhole Valley. Zone 10: 671,820E 4,678,880N. NW¼ NE¼ NW¼ NW¼ SW¼ sec. 26, T38S R15E, Barnes Valley 1988 quad., Klamath Co., Oregon. Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Lower Fishhole Valley. Unnamed spring on east side of Lower Fishhole Valley below (west of) FS3790. Elev. 5120'. Dry spring. No mollusks. 10/06/1997 TF, EJ! [B14]

257. [3128] Briggs Spring. Zone 10: 672,290E 4,678,060N. NE¼ NE¼ NW¼ NE¼ NW¼ sec. 35, T38S R15E, Barnes Valley 1988 quad., Klamath Co., Oregon. Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Lower Fishhole Valley. Briggs Spring below (west of) FS3790, south end of Lower Fishhole Valley, just north of private crossing of Fishhole Creek, Fremont National Forest. Elev. 5160'. Depth 1-4". Spring with abundant epiphytic algae; no macrophytes; mud and cobble substrate. Spring not shown on USGS map; shown on Fremont National Forest 1:126,720 map. Sphaeriids only; not retained. 10/06/1997 TF, EJ! [B14]

258. [3129] Big Swamp Creek at FS3715 crossing. Zone 10: 679,120E 4,677,980N. NE¼ SE¼ SW¼ NW¼ NE¼ sec. 33, T38S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Big Swamp Creek-Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Big Swamp Creek just above (east of) FS3715 crossing, Fremont National Forest. Elev. 5960'. Depth 1-3". Spring-influenced creek with cobble substrate; rare *Rorippa*; minor epiphytic algae. Rare *Physella* dip net collected. 10/06/1997 TF, EJ! [B10]

259. [3130] Source spring of Big Swamp Creek. Zone 10: 679,570E 4,678,140N. SW¼ SW¼ NE¼ NE¼ NE¼ sec. 33, T38S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Big Swamp Creek-Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Source spring of Big Swamp Creek, ca. 0.5 mi. east of FS3715 and north of Long Prairie, Fremont National Forest. Elev. 6080'. Depth 1-3". Spring with mixed cobble-mud substrate; common wood fragments; common *Rorippa* and epiphytic algae in slow areas. *Gyraulus* and small sphaeriids dip net collected. 10/06/1997 TF, EJ! [B10]

260. [3131] Lower Pitt Lake on southeast side. Zone 10: 678,310E 4,676,380N. SE¼ SW¼ SW¼ NW¼ NW¼ sec. 4, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Lower Pitt Lake on SE side, NW of FS3715, Fremont National Forest. Elev. 5800'. Depth 2-12". Sedge marsh; shallow muddy lake; common *Typha* and *Carex*; common epiphytic algae. Uncommon *Planorbella*; *Lymnaea stagnalis appressa*; *Stagnicola caperata*; sphaeriids; *Physella*; *Valvata*; common *Gyraulus*. Dip net collected. 10/06/1997 TF, EJ! [B10]

261. [3132] Holmes Meadow spring 1. Zone 10: 678,800E 4,671,970N. NE¼ NW¼ SW¼ SE¼ SW¼ sec. 16, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake. North-most Holmes Meadow spring to east of FS3790, west of Barnes Rim, Fremont National Forest. Elev. 5660'. Depth 1-3". Spring with mud and cobble substrate; abundant *Rorippa*; minor epiphytic algae; moderate-sized spring run; some wood fragments. North-most spring of nine springs. Very common medium *Fluminicola* n. sp.; *Promenetus umbilicatellus*; common small sphaeriids. Collected by dip net. Some grazing damage. 10/06/1997 TF, EJ! [B11]

262. [3133] Holmes Meadow spring 3. Zone 10: 678,855E 4,671,860N. Center SE¼ SW¼ SE¼ SW¼ sec. 16, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Roadside (east side of FS3790) spring ca. 0.15 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim, Fremont National Forest. Elev. 5680'. Depth 0-1". Spring in sedge and grass marsh; mud substrate; indistinct central channel. Third spring from the north of nine springs. No mollusks. Heavy grazing damage. 10/06/1997 TF, EJ! [B11]

263. [3134] Holmes Meadow spring 4. Zone 10: 678,930E 4,671,690N. NW¼ SW¼ NE¼ NE¼ NW¼ sec. 21, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Spring on east side of FS3790, ca. 0.25 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim, Fremont National Forest. Elev. 5670'. Spring in sedge and grass meadow; very minor *Rorippa*; mud substrate; no epiphytic algae; indistinct central channel. Fourth spring from the north of nine springs. No mollusks. Heavy grazing damage. 10/06/1997 TF, EJ! [B11]

264. [3135] Holmes Meadow spring 5. Zone 10: 679,010E 4,671,440N. SW¼ SE¼ SE¼ NE¼ NW¼ sec. 21, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Spring on east side of FS3790, ca. 0.5 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim. Elev. 5680'. Depth 1-3". Small spring run; mostly mud substrate; some cobbles; common *Rorippa*. Fifth spring from the north of nine springs. Rare *Fluminicola* and sphaeriids. Collected by dip net. Heavy grazing damage. 10/06/1997 TF, EJ! [B11]

265. [3136] Holmes Meadow spring 6. Zone 10: 678,920E 4,671,300N. NW¼ SW¼ NE¼ SE¼ NW¼ sec. 21, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Spring on west side of FS3790, ca. 0.7 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim. Elev. 5640'. Depth 0-1". Small marshy spring mostly sedges and grasses; mud substrate; has 3 separate channels. Sixth spring from the north of nine springs. Rare *Fluminicola*; not collected. 10/06/1997 TF, EJ! [B11]

266. [3137] Holmes Meadow spring 7. Zone 10: 678,900E 4,671,210N. SE¼ SE¼ NW¼ SE¼ NW¼ sec. 21, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes

Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Small spring run on north side of FS3790, ca. 0.75 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim. Elev. 5640'. Depth 1-3". Small muddy spring run; mud, some cobbles; common wood fragments; abundant *Rorippa*. Seventh spring from the north of nine springs. Uncommon *Fluminicola*, *Promenetus umbilicatellus*, and sphaeriids. Dip net collected. Heavy grazing damage. 10/06/1997 TF, EJ! [B11]

267. [3138] Holmes Meadow spring 8. Zone 10: 678,820E 4,670,840N. SW¼ SE¼ NW¼ NE¼ SW¼ sec. 21, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Small spring to the west of FS3790, ca. 1.0 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim, Fremont National Forest. Elev. 5660'. Spring in sedge and grass meadow; indistinct channel; no macrophytes; no algae. Eighth spring from the north of nine springs. No mollusks. Very heavily grazed. 10/06/1997 TF, EJ! [B11]

268. [3139] Holmes Meadow spring 9. Zone 10: 678,850E 4,670,740N. SW¼ NE¼ SW¼ NE¼ SW¼ sec. 21, T39S R16E, Arkansas Flat 1988 quad., Lake Co., Oregon. Lapham Creek-Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Small spring to the east of FS3790, ca. 1.05 rd. mi. south of north-most Holmes Meadow spring 1, west of Barnes Rim, Fremont National Forest. Elev. 5680'. Spring in sedge and grass meadow; indistinct channel; no macrophytes; no algae. South-most spring of nine springs. No mollusks. Heavily grazed. 10/06/1997 TF, EJ! [B11]

269. [3140] Unnamed Fishhole Creek spring source 1. Zone 10: 665,560E 4,684,360N. NW¼ NW¼ NW¼ NE¼ NW¼ sec. 7, T38S R15E, Paradise Mountain 1988 quad., Klamath Co., Oregon. Unnamed Creek-Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring 0.9 mi. NW of FS3752 bridge over Robinson Spring Creek, south side of FS3752. Elev. 5110'. Depth 1-3". Spring mostly in a sedge meadow with mixed mud and cobble substrate; very rare *Rorippa*. Small sphaeriids only; not retained. 10/06/1997 TF, EJ! [B77]

270. [3141] Unnamed Fishhole Creek spring source 2. Zone 10: 664,450E 4,685,100N. NE¼ NE¼ NW¼ NW¼ SE¼ sec. 1, T38S R14E, Horsefly Mountain 1988 quad., Klamath Co., Oregon. Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Unnamed spring 1.0 mi. east of Penney Hill, SW side of FS3752, Fremont National Forest. Elev. 5020'. Small spring in a sedge meadow and grass meadow. No consistent flow. Small sphaeriids only; not retained. Heavily grazed. 10/06/1997 TF, EJ! [B51]

271. [3142] Sprague River first east of Beatty Gap. Zone 10: 647,060E 4,699,870N. SW¼ SE¼ SE¼ NE¼ NE¼ sec. 19, T36S R13E, Ferguson Mountain 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sprague River on north side of OR140 (Klamath Falls-Lakeview Highway), 1.5 rd. mi. east of power lines, ca. 1.5 mi. SE of Beatty Gap. Elev. 4310'. Depth 6-24". River with mostly mud; some gravel and cobbles; common plant fragments; common *Elodea*; some epiphytic algae. Common *Fluminicola*, sphaeriids; small *Gonidea angulata*; uncommon *Vorticifex*, *Physella*. Dip net collected. 10/06/1997 TF, EJ! [B38]

272. [3143] Sprague River second east of Beatty Gap. Zone 10: 648,500E 4,700,100N. SE¼ NE¼ NW¼ NE¼ NE¼ sec. 20, T36S R13E, Ferguson Mountain 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sprague River on north side of OR140 (Klamath Falls-Lakeview Highway), 2.4 rd. mi. east of power lines, ca. 2.5 mi. SE of Beatty Gap. Elev. 4310'. Depth 6-18". River with mostly mud

substrate; occasional cobbles; very patchy *Elodea*. Rare *Fluminicola*; recently dead *Margaritifera falcata*. Hand and dip net collected. River possibly dredged recently. 10/06/1997 TF, EJ! [B38]

273. [3144] Sprague River north of Sprague River. Zone 10: 622,920E 4,702,050N. SE¼ SE¼ SE¼ NE¼ SE¼ sec. 10, T36S R10E, Sprague River West 1985 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Sprague River at RM 50.15, on SW side of Sprague River Road bridge (Klamath County 858, FS58) at public fishing access, 0.5 mi. north of town of Sprague River. Elev. 4280'. Depth 6-38". River with abundant epiphytic algae; common *Elodea* patches nearshore; *Potamogeton crispus* offshore; mud substrate. Rare *Fluminicola*; sphaeriids. Collected with dip net. 10/07/1997 TF, EJ! [B91]

274. [3145] Sprague River south of Lone Pine. Zone 10: 613,440E 4,711,740N. W½ NE¼ NE¼ NW¼ SW¼ sec. 11, T35S R9E, Buttes of the Gods 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Sprague River Valley. Sprague River at FS5850 bridge (east side), 0.3 mi. south of Lone Pine. Elev. 4270'. Depth 6-18". River with mud, local bedrock and cobble substrate; abundant epiphytic algae; common *Elodea* and *Potamogeton crispus*. Common *Fluminicola* and various sphaeriids; also *Physella*, *Stagnicola*; *Gyraulus*; very rare *Valvata humeralis*; common dead *Gonidea angulata*. 10/07/1997 TF, EJ! [B24]

275. [3146] Sprague River 1 in S' Ocholis Canyon. Zone 10: 610,900E 4,712,660N. NE¼ SE¼ SW¼ SW¼ SE¼ sec. 4, T35S R9E, S' Ocholis Canyon 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sprague River in eastern S' Ocholis Canyon Winema National Forest public fishing access area, just off (south of) Sprague River Road (Klamath County 858; FS58). Elev. 4270'. Depth 1-5'. River with mud and sand substrate; diatomite cobbles; scattered *Elodea* on NE side of site. *Fluminicola*, *Physella* and rare *Pyrgulopsis* collected with dip net. 10/07/1997 TF, EJ! [B83]

276. [3147] Sprague River 2 in S' Ocholis Canyon. Zone 10: 609,420E 4,712,580N. SW¼ SE¼ SE¼ SW¼ SE¼ sec. 5, T35S R9E, S' Ocholis Canyon 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Sprague River in western S' Ocholis Canyon Winema National Forest public fishing access area (north side), just off (south of) Sprague River Road (Klamath County 858; FS58). Elev. 4270'. Depth 2-48". River with abundant *Elodea*; common *Potamogeton crispus* and epiphytic algae; mud, sand, and cobble substrate. Uncommon *Pyrgulopsis* near shore; common *Fluminicola*; uncommon *Physella*; common dead *Gonidea angulata*. Dip net and hand collected. 10/07/1997 TF, EJ! [B83]

277. [3148] Cedar Spring west of Saddle Mountain. Zone 10: 608,420E 4,707,800N. NW¼ SE¼ SW¼ SW¼ SW¼ sec. 20, T35S R9E, S' Ocholis Canyon 1988 quad., Klamath Co., Oregon. Unnamed Creek-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Cedar Spring in bed of creek west of FS22, west side of Saddle Mountain and east of Ya Whee Plateau, ca. 5.1 mi. north of junction with Sprague River Road (Klamath County 858; FS58), Winema National Forest. Elev. 5140'. Depth 1-2". Very shallow spring; *Equisetum* meadow with *Salix* and *Spiranthes*; multiple very small channels; common wood; mud-cobble substrate. No mollusks. 10/07/1997 TF, EJ! [B84]

278. [3149] Sprague River east of Braymill. Zone 10: 598,000E 4,717,490N. NW¼ SW¼ NW¼ SE¼ SW¼ sec. 20, T34S R8E, Chiloquin 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. NE side of Sprague River at public fishing access off (south of) Sprague River Road (Klamath County 858; FS58), ca. 0.8 mi. east of site of Braymill, Winema National Forest. Elev. 4250'. Depth 2-48". River with mud,

sand, and cobble substrate, including cobble bar; common *Elodea* and *Potamogeton crispus* nearshore; some epiphytic algae. Common *Pyrgulopsis* and abundant *Fluminicola*; lesser *Vorticifex*, *Physella*, sphaeriids, *Gyraulus*; common *Gonidea angulata*. Hand and dip net collected. 10/07/1997 TF, EJ! [B30]

279. [3150] Sprague River southeast of Chiloquin. Zone 10: 595,360E 4,712,660N. NW¼ SW¼ NE¼ NE¼ SE¼ sec. 2, T35S R7E, Chiloquin 1988 quad., Klamath Co., Oregon. Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. East side of Sprague River, ca. 1.7 mi. south of Sprague River Road (Klamath County 858; FS58) on FS5810, 1.5 mi. SE of Chiloquin. Elev. 4190'. Depth 1-2'. River with abundant epiphytic algae; uncommon *Potamogeton crispus* and minor *Elodea* near shore; mostly cobble and gravel substrate. Uncommon sphaeriids, *Physella*, *Planorbella*, *Fluminicola*; rare *Lyogyrus*. Hand and dip net collected. 10/07/1997 TF, EJ! [B31]

280. [3151] Williamson River at Chiloquin County Park. Zone 10: 529,100E 4,713,530N. SW¼ SE¼ SE¼ NE¼ NE¼ sec. 4, T35S R7E, Agency Lake 1985 quad., Klamath Co., Oregon. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. SW side of Williamson River at Klamath County Park adjacent to Chiloquin Airport, off (SE of) Klamath County 1331. Elev. 4150'. Depth 6-38". River with primarily bedrock (diatomite?) with scattered cobbles, gravel, and mud patches; rare macrophytes (*Potamogeton crispus*, *Elodea*) and very rare epiphytic algae; medium-sized river. Very common *Lanx*; common *Fluminicola*; minor *Vorticifex*, *Physella*, *Menetus*, *Gyraulus*, and sphaeriids. Dip net and hand collected. 10/08/1997 TF, EJ! [B6]

281. [3152] Williamson River on northwest side of Pine Ridge Road bridge. Zone 10: 593,540E 4,716,180N. NW¼ SE¼ NW¼ NE¼ SE¼ sec. 27, T34S R7E, Chiloquin 1988 quad., Klamath Co., Oregon. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Pool in the Williamson River on the NW side of Pine Ridge Road bridge, east of Pine Ridge. Elev. 4170'. Depth 2-48". River with primarily oxygenated mud with cobbles near shore; some *Potamogeton crispus* beds; common plant fragments. Common small *Carinifex*, *Fluminicola*; uncommon *Lanx* near shore; rare *Vorticifex*; uncommon small sphaeriids. Dip net and hand collected. 10/08/1997 TF, EJ! [B31]

282. [3153] Williamson River on southwest side of Pine Ridge Road bridge. Zone 10: 593,540E 4,716,140N. SW¼ SE¼ NW¼ NE¼ SE¼ sec. 27, T34S R7E, Chiloquin 1988 quad., Klamath Co., Oregon. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Pool and cutoff of the Williamson River on the SW side of Pine Ridge Road bridge, east of Pine Ridge. Elev. 4170'. Depth 2-36". River with mud substrate with some scattered cobbles and gravels; scattered *Myriophyllum*. Very large *Carinifex*; *Fluminicola*; common large sphaeriids; rare *Lanx*. Collected with a dip net. 10/08/1997 TF, EJ! [B31]

283. [3154] Larkin Creek. Zone 10: 593,800E 4,722,380N. SE¼ SE¼ SW¼ NW¼ SW¼ sec. 2, T34S R7E, Soloman Butte 1988 quad., Klamath Co., Oregon. Larkin Creek-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Larkin Creek at FS5812-258 terminus, ca. 0.3 mi. SE of junction with Williamson River, about 0.25 mi. north of Collier Memorial State Park Boundary, Winema National Forest. Elev. 4195'. Depth 1-7". Very cold, swift spring creek with silt-pumice sand substrate; scattered *Veronica*. No mollusks. 10/08/1997 TF, EJ! [B85]

284. [3155] Williamson River at bridge of FS9730. Zone 10: 594,680E 4,723,920N. SW¼ NW¼ NE¼ SW¼ SE¼ sec. 35, T33S R7E, Soloman Butte 1988 quad., Klamath Co., Oregon. Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Williamson River 0.5 mi. north of Williamson River Campground just above bridge of FS9730, Winema National Forest. Elev.

4195'. Depth 1-12". River with cobble and boulder substrate; minor *Rorippa* and Mimulus; minor epiphytic algae. Sporadic *Lanx*, *Fluminicola* (locally common); *Lyogyrus*. Hand collected. 10/08/1997 TF, EJ! [B85]

285. [3156] Fort Creek at crossing of OR62. Zone 10: 584,240E 4,725,720N. SE¼ SW¼ NE¼ NW¼ SW¼ sec. 26, T33S R7 ½E, Fort Klamath 1985 quad., Klamath Co., Fort Oregon. Fort Creek-Wood River-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Wood River Valley. Fort Creek on SW side of OR62 (Crater Lake Highway) crossing. Elev. 4158'. Depth 6-40". Large cold spring-fed creek and pool; red algae; rare epiphytic algae; oxygenated mud and gravel-cobble substrate. Abundant *Fluminicola*; common sphaeriids, *Menetus*; rarer *Vorticifex*, *Physella*. Dip net collected. 10/09/1997 TF, EJ! [B40]

286. [3158] South spring of Blue Springs. Zone 10: 575,780E 4,727,000N. NW¼ NE¼ NE¼ SE¼ SE¼ sec. 23, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co., Oregon. Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Cascade Range. South-most source spring of Blue Springs on east side of FS3300 at rd. mi. 2.0, Winema National Forest. Elev. 4180'. Depth 6-24". Small oligotrophic spring; abundant wood fragments; no macrophytes or epiphytic algae. Common medium-sized *Fluminicola* in limited area (at source). Collected by dip net and off wood fragments. 10/09/1997 TF, EJ! [B67]

287. [3160] Unnamed spring 0.2 mile south of Blue Springs. Zone 10: 575,700E 4,727,660N. SW¼ SW¼ SE¼ SE¼ SE¼ sec. 23, T33S R6E, Mares Egg Spring 1985 quad., Klamath Co., Oregon. Sevenmile Creek-Agency Lake-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River, Cascade Range. Small spring on east side of FS3300 at aboutrd. mi. 2.2, ca. 0.2 rd. mi. south of Blue Springs. Elev. 4180'. Depth 1-2". Small oligotrophic spring with cobble substrate; no macrophytes or epiphytic algae; small Rivularia. Spring not shown on USGS map. Moderately common medium-sized *Fluminicola*. Dip net and hand collected. 10/09/1997 TF, EJ! [B67]

288. [3161] Upper Klamath Lake south of Modoc Point. Zone 10: 593,180E 4,699,000N. SW¼ SW¼ SW¼ NW¼ NE¼ sec. 22, T36S R7E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. East side of Upper Klamath Lake at a fishing access, 0.45 mi. south of Modoc Point, west of US97 (The Dalles-California Highway), Winema National Forest. Elev. 4143'. Depth 1-5'. Lake with *Scirpus* marsh near shore; mixed cobble, gravel, and mud substrate; common sponges on rock undersides; epiphytic algae common; underlying peat. Abundant *Fluminicola*; *Vorticifex*; uncommon *Pyrgulopsis*; rare *Lyogyrus* and *Physella*; common sphaeriids locally, including *Pisidium ultramontanum*. Collected by kicking cobbles into dip nets. 10/10/1997 TF, EJ! [B73]

289. [3163] Upper Klamath Lake southwest of Hagelstein County Park. Zone 10: 597,680E 4,692,660N. Quarter sections not practical; sec. 6, T37S R9E, Modoc Point 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. East side of Upper Klamath Lake SW of Hagelstein County Park, west of US97 (The Dalles-California Highway) and BN-SPRR track. Elev. 4143'. Depth 36-48". Channel in *Scirpus* marsh (lake); mud substrate; common plant fragments; some pumice; buried peat. Moderately common *Valvata*; no sphaeriids. Dip net collected. 10/10/1997 TF, EJ! [B72]

290. [3164] Upper Klamath Lake at US97 rd. mi. 263.9. Zone 10: 597,420E 4,691,760N. Projected from SE corner, NW¼ NW¼ NE¼ NE¼ NE¼ sec. 12, T37S R8E, Wocus 1985 quad., Klamath Co., Oregon. Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. East side of Upper Klamath Lake, west of BN-SPRR track and US97 (The Dalles-California Highway) at rd. mi. 263.9. Elev. 4143'. Depth 36-48". Channeled *Scirpus* marsh (lake); mud with some plant fragments and common pumice; buried peat surface. Uncommon *Valvata*; rare sphaeriids; dead *Planorbella* (not retained). Dip net collected. 10/10/1997 TF, EJ! [B97]

291. [3167] Fishhole Creek 0.5 mile north of FS011. Zone 10: 669,150E 4,684,440N. NE¼ NE¼ NE¼ NE¼ NW¼ sec. 9, T38S R15E, Paradise Mountain 1988 quad., Klamath Co., Oregon. Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Fishhole Creek on west side of FS3790 about 0.5 mi. north of junction of FS011, Fremont National Forest. Elev. 4795'. Depth 1-3". Creek with cobble bottom; some epiphytic algae. No mollusks. 10/06/1997 TF, EJ! [B77]

292. [3168] Boundary Spring. Zone 10: 659,180E 4,676,040N. SE¼ SE¼ NE¼ NW¼ NW¼ sec. 4, T39S R14E, Gerber Reservoir 1988 quad., Klamath Co., Oregon. Barnes Valley Creek-Miller Creek-Lost River-Lower Klamath Lake Boundary Spring 0.15 mi. east of BLM41-14E-11 and 0.1 mi. south of Fremont National Forest boundary in BLM lands. Elev. 5000'. Depth 0-1". Spring with mud-cobble substrate. No mollusks. 10/04/1997 TF, EJ! [B45]

293. [3170] Robinson Spring Creek. Zone 10: 666,440E 4,683,480N. Center NW¼ NE¼ SE¼ sec. 7, T38S R15E, Paradise Mountain 1988 quad., Klamath Co., Oregon. Robinson Spring Creek-Fishhole Creek-South Fork Sprague River-Sprague River-Williamson River-Upper Klamath Lake-Link River-Lake Ewauna-Klamath River. Robinson Spring Creek on west side of FS3752. Elev. 5100'. Depth 1-4". Spring creek with *Potamogeton crispus* and epiphytic algae; exposed travertine substrate. No mollusks. 10/06/1997 TF, EJ! [B77]

these descriptions do not match map.

294. [3315] Upper Klamath Lake east of Bare Island. Zone 10: 592,000E 4,696,700N. Shoalwater Bay 1985 quad. Klamath Co. Oregon. Upper Klamath Lk.-Link R.-Lk. Ewauna-Klamath R. Upper Klamath Lake about 2.3 mi. E. of Bare Island, 2.0 mi. SW of Modoc Point; about 1 mi. long dredge in a NW direction. Elev. 4143'. Depth 10-15'. Lake with mud bottom. Collection made with 16' otter trawl towed behind a 17' Boston Whaler. Abundant *Carinifex*, *Fluminicola* n. sp. 1; rare *Planorbella*. Oregon State University site #A97803. 10/10/1997 DCS!

295. [3316] Upper Klamath Lake north of Ball Point. Zone 10: 581,340E 4,698,600N. Pelican Bay 1985 quad. Klamath Co. Oregon. Upper Klamath Lk.-Link R.-Lk. Ewauna-Klamath R. Upper Klamath Lake about 1.5 mi. N. of Ball Point and 1.4 mi. NE of Coon Point; about 1 mi. long dredge in a SW direction. Elev. 4143'. Depth 10-15'. Lake with mud bottom. Collection made with 16' otter trawl towed behind a 17' Boston Whaler. *Carinifex* and *Fluminicola* n. sp. 1. Oregon State University site #A97813. 10/12/1997 DCS!

296. [3317] Upper Klamath Lake southwest of Agency Strait. Zone 10: 580,600E 4,702,280N. Pelican Bay 1985 quad. Klamath Co. Oregon. Upper Klamath Lk.-Link R.-Lk. Ewauna-Klamath R. Upper Klamath Lake about 1.7 mi. SW of mouth of Agency Strait and 2.5 mi. NE of mouth of Pelican Bay; about 1 mi. long dredge in a SW direction. Elev. 4143'. Depth 10-15'. Lake with mud bottom. Collection made with 16' otter trawl towed behind a 17' Boston Whaler. Abundant *Carinifex* and *Fluminicola* n. sp. 1. Oregon State University #A97815. 10/12/1997 DCS!

APPENDIX B. SITE MAPS.

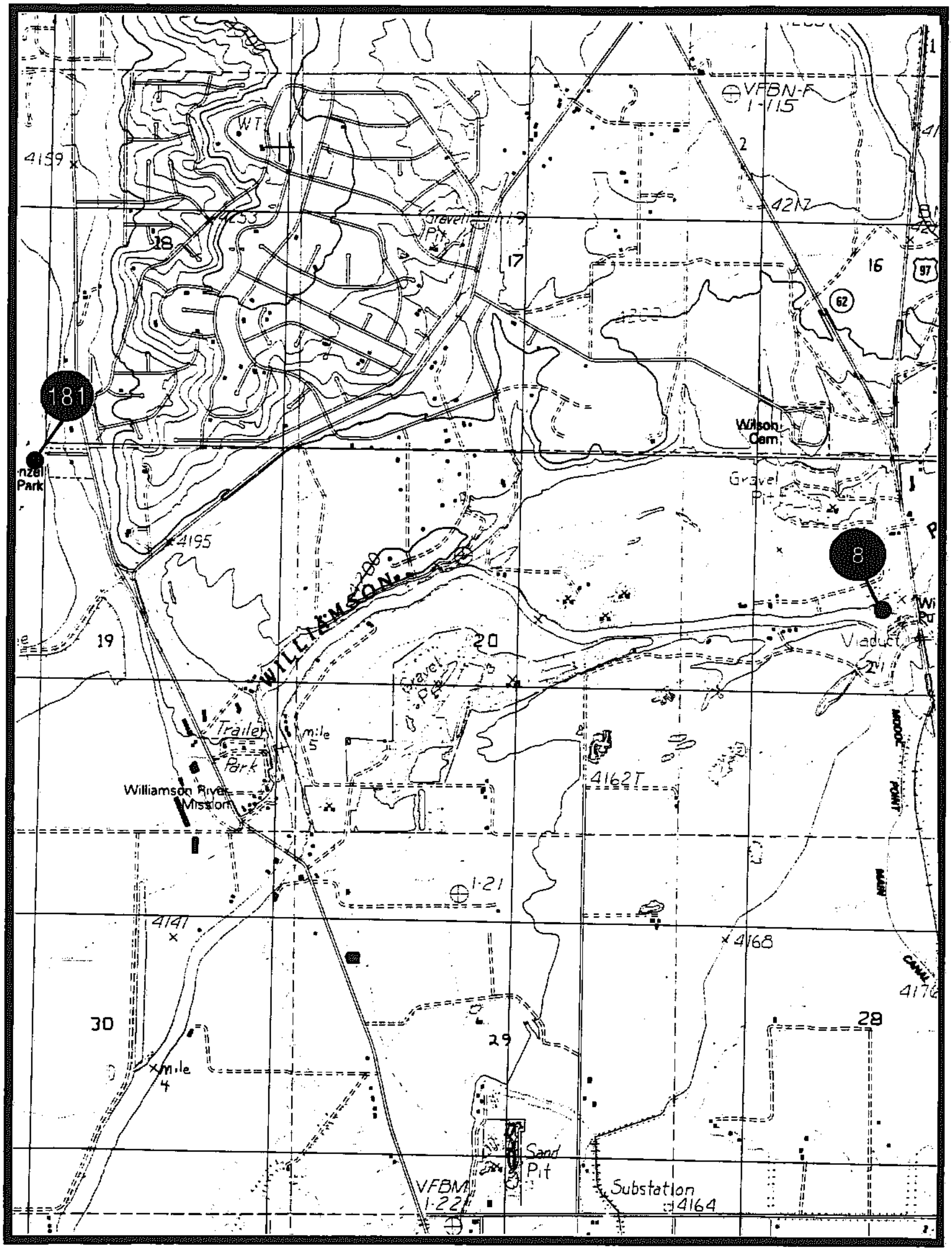
Maps of localities visited during this survey. Base map derived from appropriate USGS 7.5' topographic series and at same scale (1:24,000). For details see Appendix A.

QUADRANGLE	SITES	MAP
Agency Lake	8, 181	B4
Agency Lake 4212158	48	B5
Agency Lake	280	B6
Altamont – 4212126	227	B7
Antler Point	138-141, 183	B8
Antler Point 4212018	239-241	B9
Arkansas Flat	258-260	B10
Arkansas Flat 4212027	261-268	B11
Aspen Lake	162-165	B12
Aspen Lake 4212231	166-171	B13
Barnes Valley – 4212028	256-257	B14
Beatty	30, 185, 252-253	B15
Beatty 4212143	186	B16
Bly – 4212141	255	B17
Bonanza	80, 142-145	B18
Bonanza 4212124	232	B19
Brady Butte	133	B20
Brady Butte 4212111	134-137	B21
Brady Butte	242	B22
Bryant Mountain – 4212113	233	B23
Buttes of the Gods - 4212155	274	B24
Calimus Butte – 4212165	111-113	B25
Chicken Hills	10-11, 27	B26
Chicken Hills 4212211	26, 132	B27
Chicken Hills	131	B28
Chiloquin	93-94, 118	B29
Chiloquin 4212157	117, 278	B30
Chiloquin	279, 281-282	B31
Crystal Spring	24, 33-34	B32
Crystal Spring	35-37, 66	B33
Dairy	102	B34
Dairy	228-230	B35
Devils Peak	159	B36
Ferguson Mountain	29, 254	B37
Ferguson Mountain	271-272	B38
Fort Klamath	1, 4, 55	B39
Fort Klamath	47, 53-54, 285	B40
Fort Klamath	2-3, 5, 45-46, 49-52	B41
Fort Klamath	65, 95	B42
Fuego	61	B43
Fuego Mtn.	114-116	B44
Gerber Reservoir	84-87, 246, 292	B45
Gerber Reservoir	88-92, 244-245	B46

QUADRANGLE	SITES	MAP
Gerber Reservoir	243	B47
Goodlow Mountain	81-83	B48
Goodlow Mountain	103	B49
Horsefly Mountain	247	B50
Horsefly Mountain	270	B51
Howard Bay	19	B52
Keno	100	B53
Klamath Falls	6, 130, 178, 187, 211-223, 294-295	B54
Klamath Falls	224-225	B55
Lake of the Woods North	104-105	B56
Lake of the Woods North	173	B57
Lake of the Woods North	177	B58
Lake of the Woods South	73-75	B59
Lake of the Woods South	76-79	B60
Lake of the Woods South	146-150	B61
Langell Valley	234	B62
Langell Valley	235-238	B63
Lost River	226	B64
Lost River	250-251	B65
Maklaks Crater	109-110	B66
Mares Egg Spring	25, 40-44, 68-71, 155-156, 286-287	B67
Mares Egg Spring	38-39, 172	B68
Mares Egg Spring	160-161	B69
Merrill	248-249	B70
Military Crossing	58	B71
Modoc Point	7, 16-18, 96-99, 128-129, 191-193, 195-210, 289	B72
Modoc Point	127, 288	B73
Mule Hill	12-13, 188	B74
Mule Hill	14	B75
Paradise Mountain	28	B76
Paradise Mountain	269, 291, 293	B77
Pelican Bay	23, 67, 158, 180	B78
Pelican Bay	20-22, 56-57, 184	B79
Pelican Butte	101	B80
Shoalwater Bay	157	B81
Silver Dollar Flat	119	B82
S' Ocholis Canyon	275-276	B83
S' Ocholis Canyon	277	B84
Soloman Butte	62-64, 106, 283-284	B85
Soloman Butte	179	B86
Spencer Creek	72, 174	B87
Spodue Mtn.	120	B88
Spodue Mtn.	121-124, 182	B89
Sprague River West	125-126	B90
Sprague River West	273	B91
Sugarpine Mtn. NW	175-176	B92
Surveyor Mountain	151-154	B93
Union Peak	107-108	B94
Whiteline Reservoir	194	B95

QUADRANGLE	SITES	MAP
Whiteline Reservoir	231	B96
Wocus	9, 15, 189-190, 290	B97
Wocus Bay	59-60	B98
Yonna	31-32	B99

√



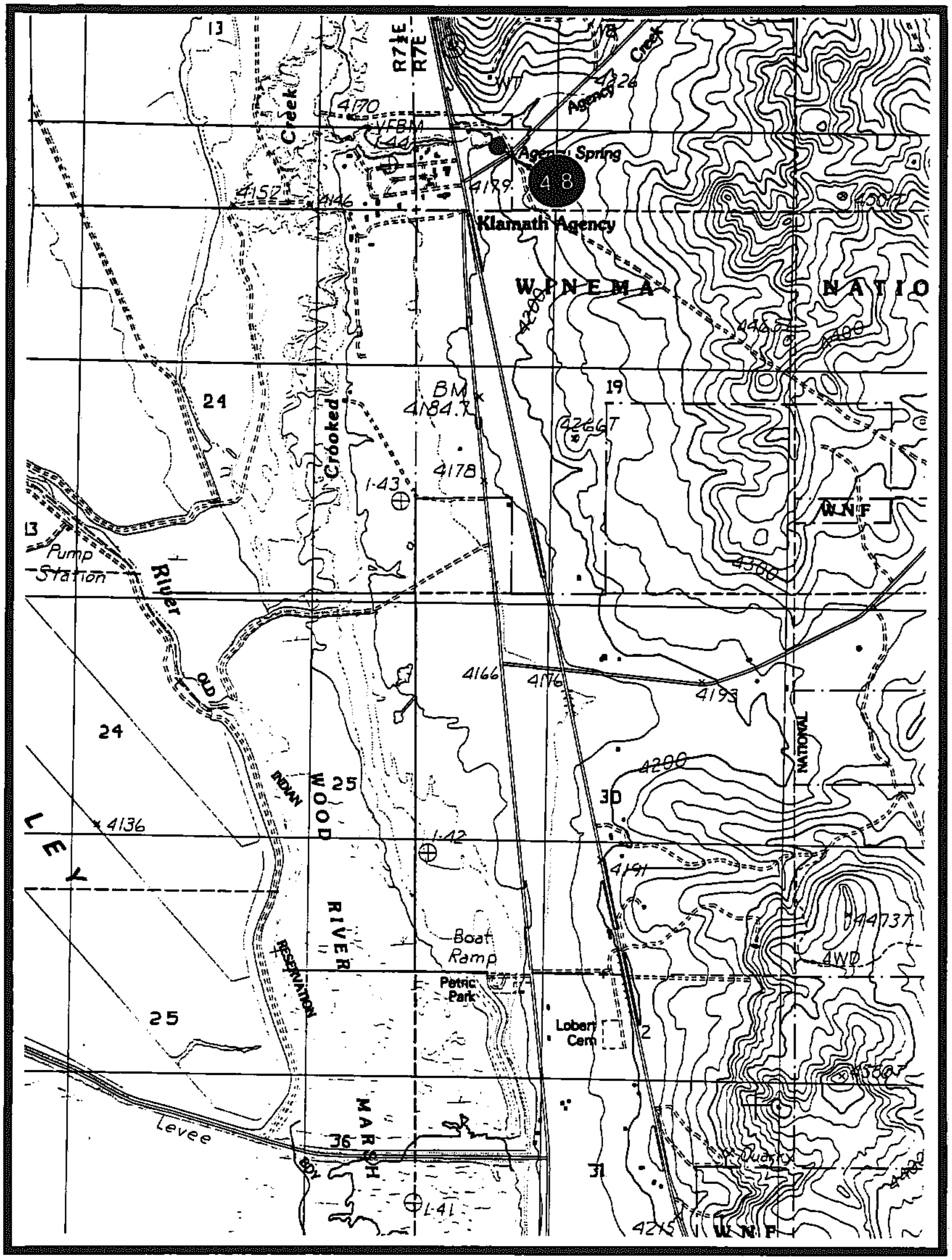
AGENCY LAKE QUADRANGLE, KLAMATH CO., OR
SITES 8, 181

4212158

Site 181 = ∅

B4

Site 8 = crooked creek .011
mare's egg .003
Lanx alta .001

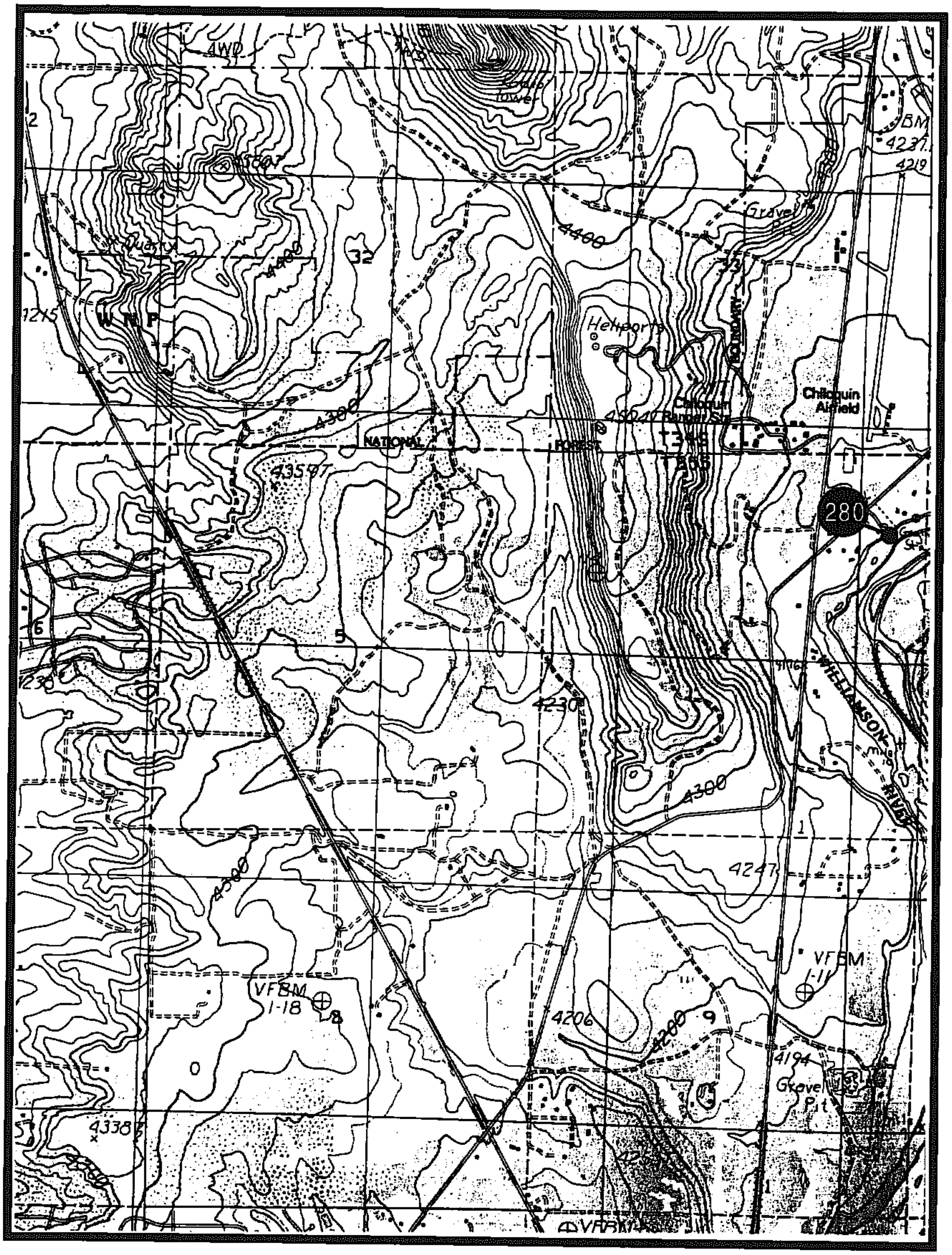


AGENCY LAKE QUADRANGLE, KLAMATH CO., OR
SITE 48 = Crooked creek .012
= Sihitzini .002

42 121 58

B5

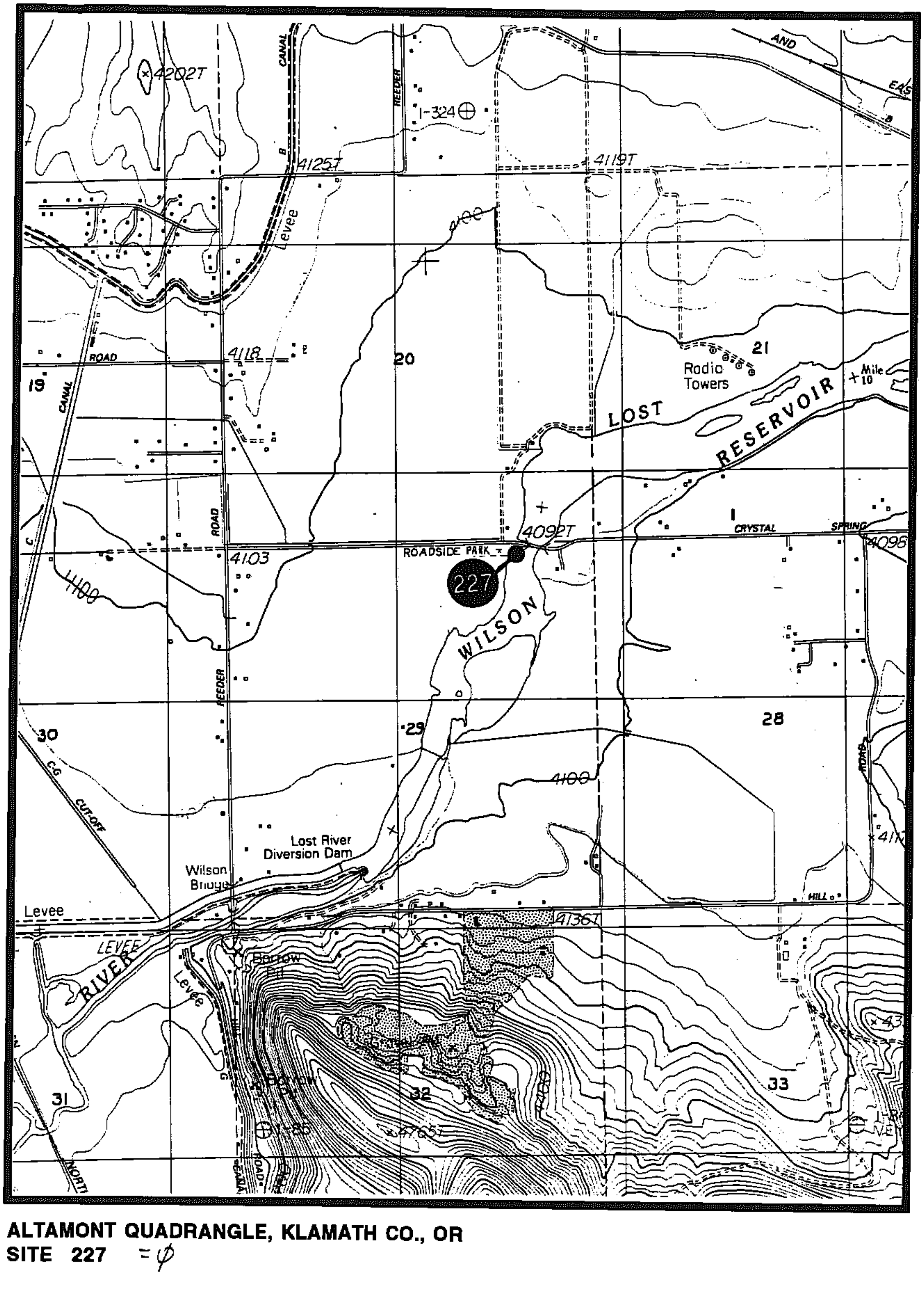
√



AGENCY LAKE QUADRANGLE, KLAMATH CO., OR
SITE 280 = ∅

B6

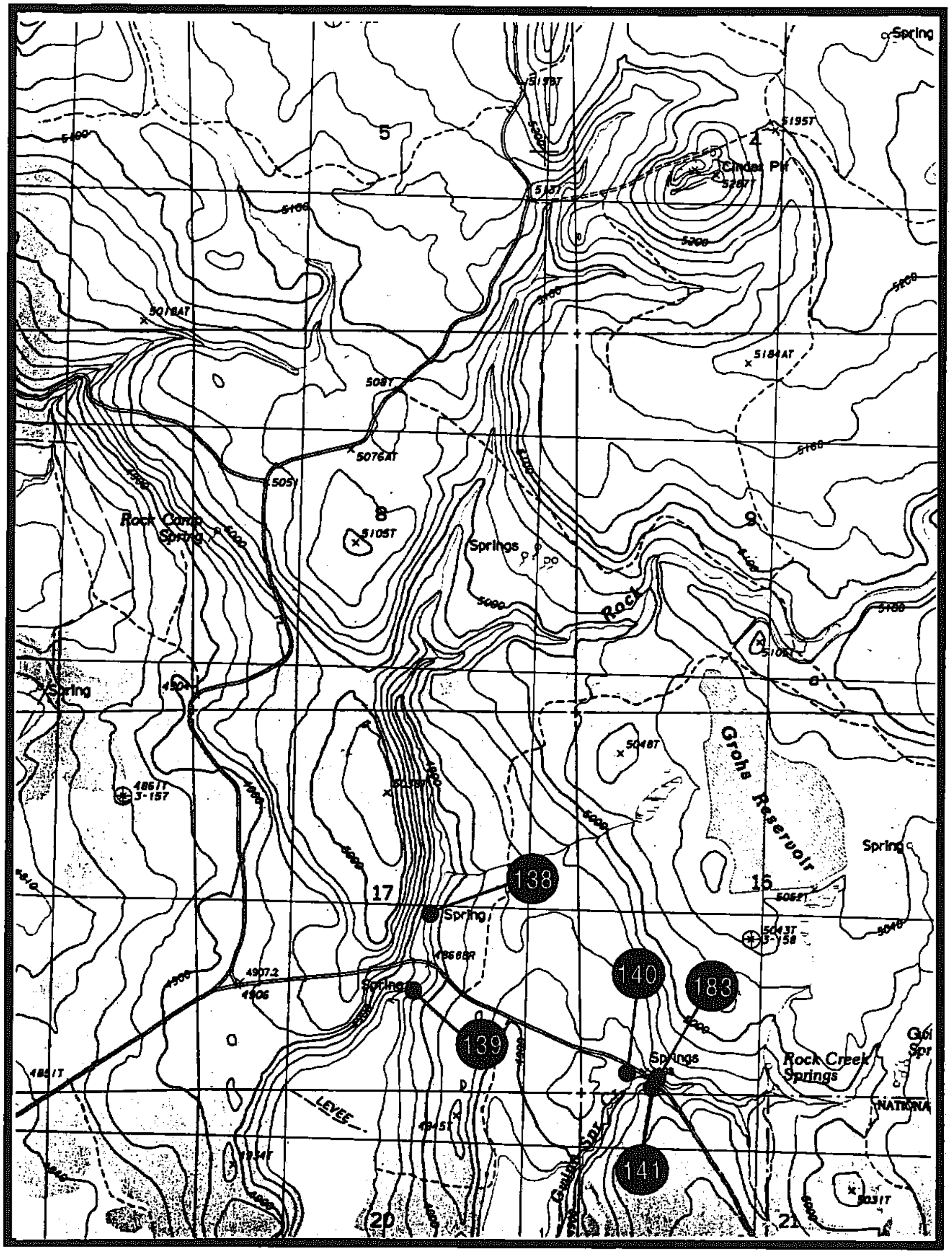
4212126



ALTAMONT QUADRANGLE, KLAMATH CO., OR
SITE 227 =ϕ

B7

4212018 √



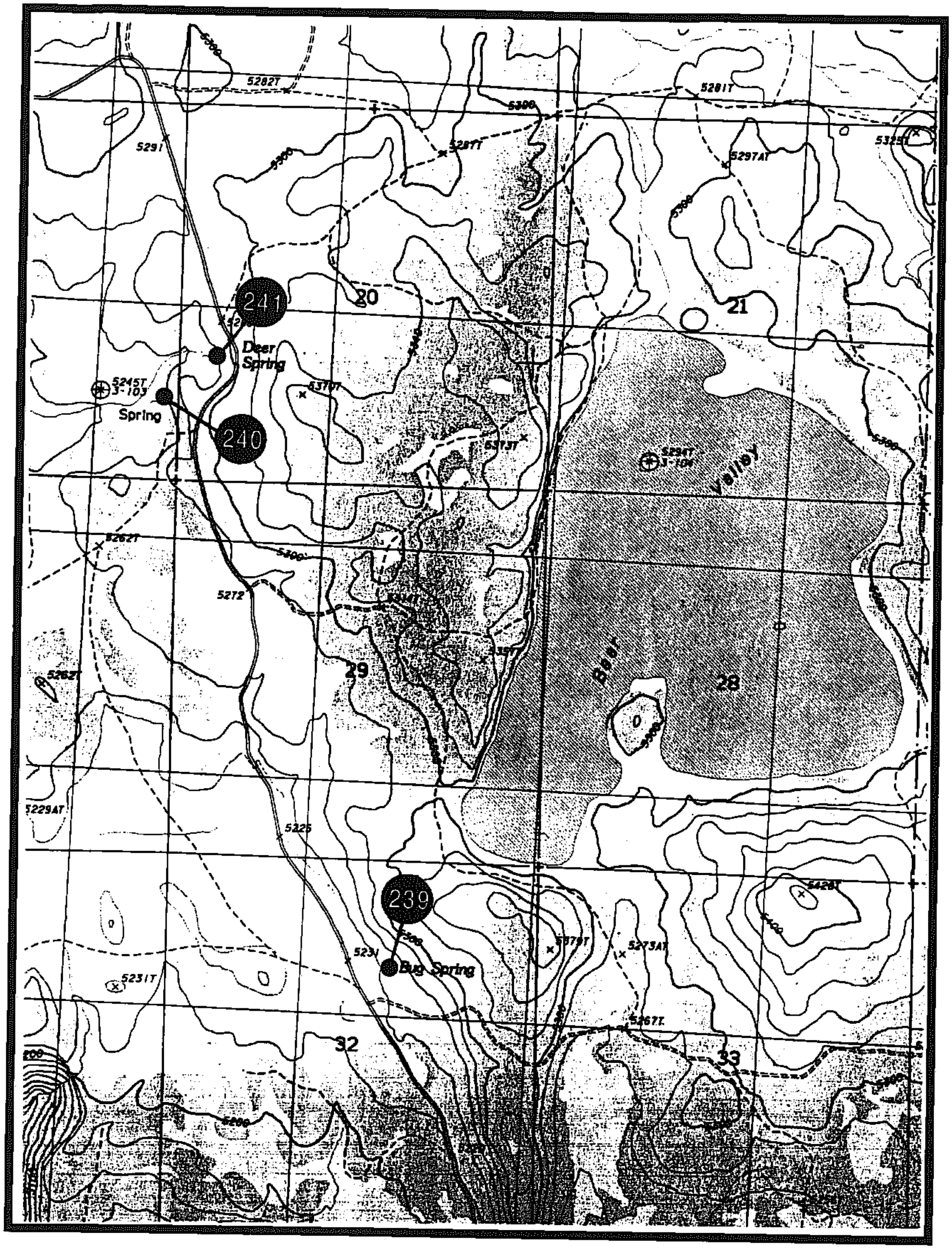
ANTLER POINT QUADRANGLE, KLAMATH & LAKE COS., OR
SITES 138, 139, 140, 141, 183

140 = Ø
138 = Ø

139 = Lake of woods .010

B8

183/141 = Lake of woods .009

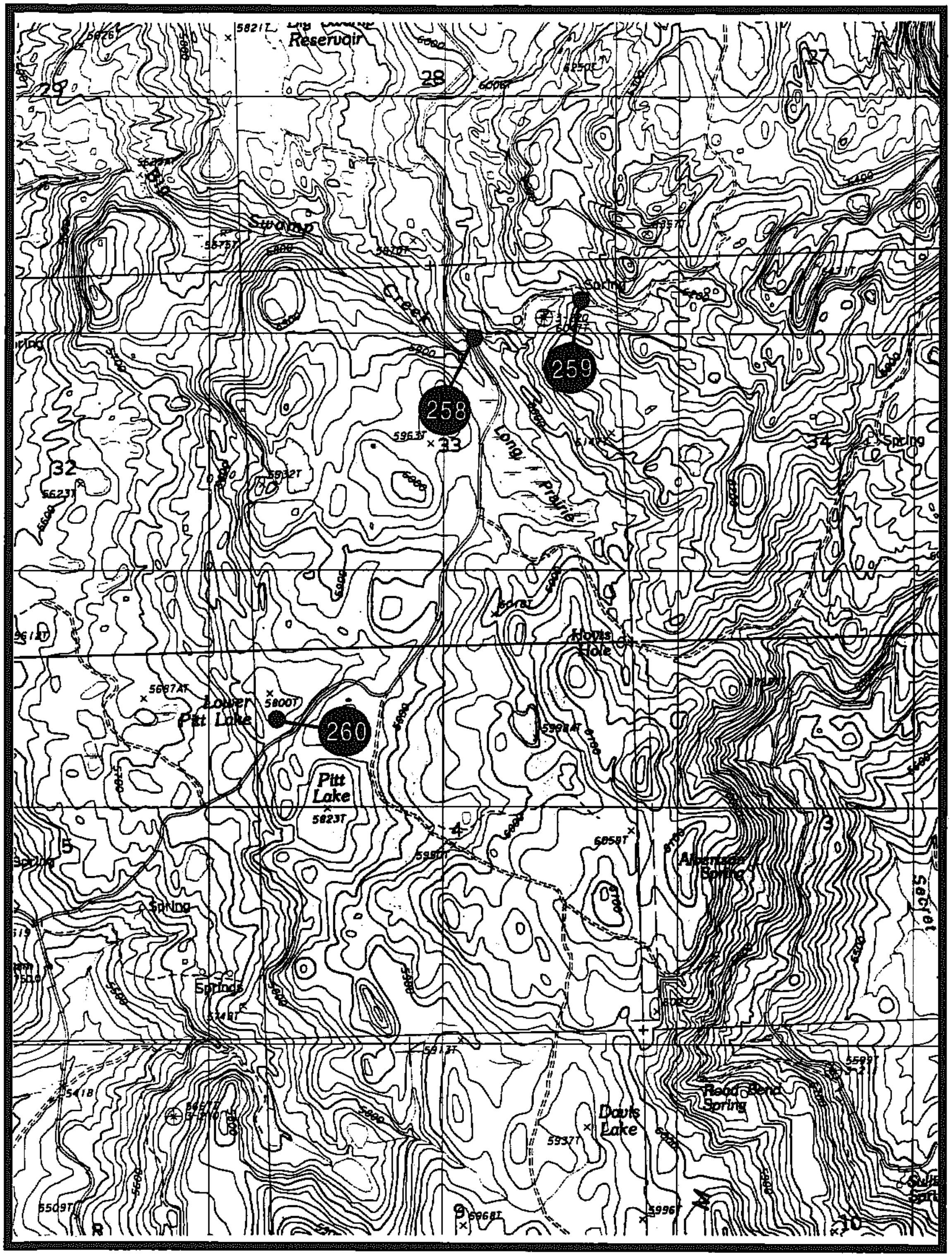


ANTLER POINT QUADRANGLE, KLAMATH & LAKE COS., OR
SITES 239, 240, 241

241 = Ø
240 = Φ
239 = Φ

B9

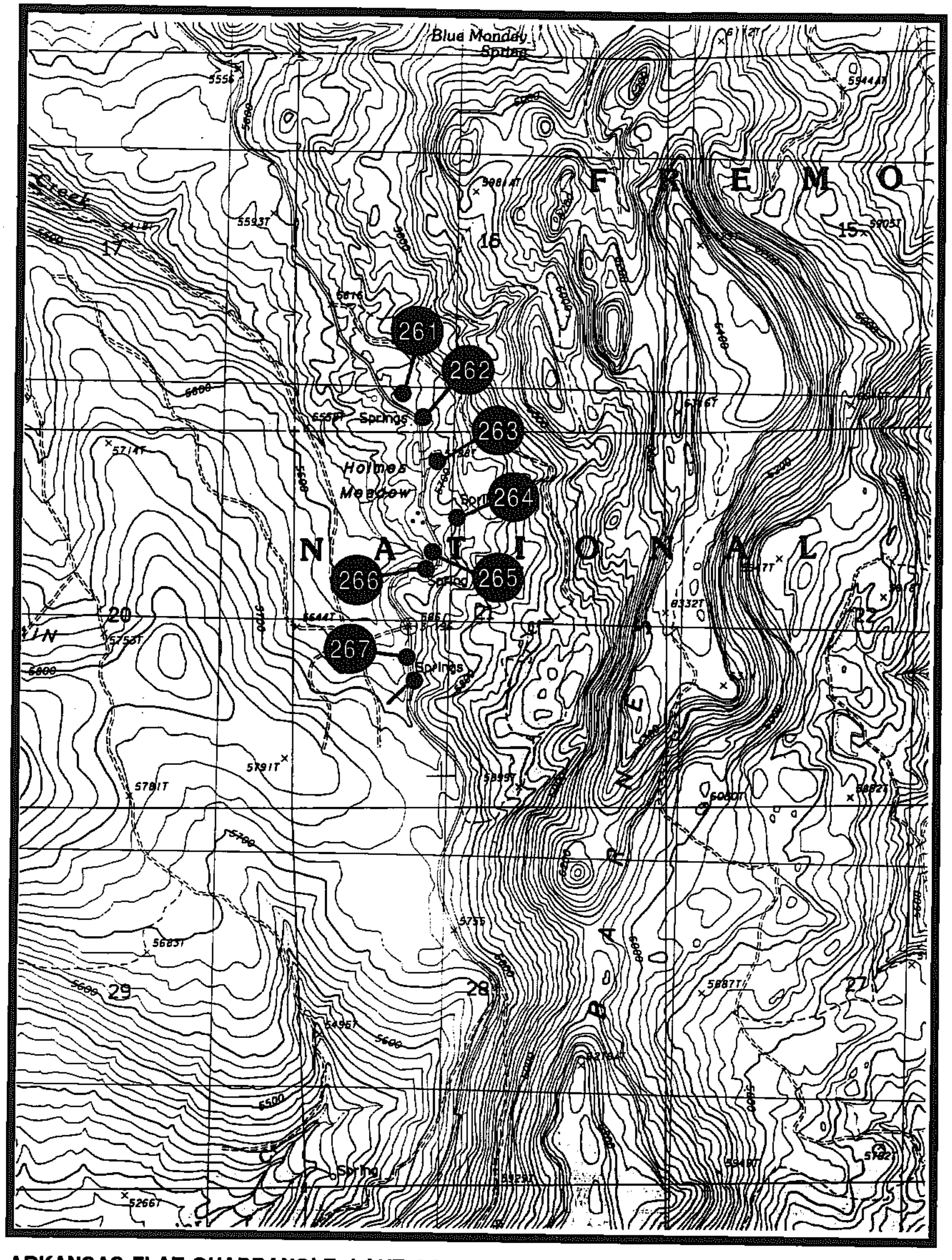
4212027 J



ARKANSAS FLAT QUADRANGLE, LAKE CO., OR
SITES 258, 259, 260 = φ

B10

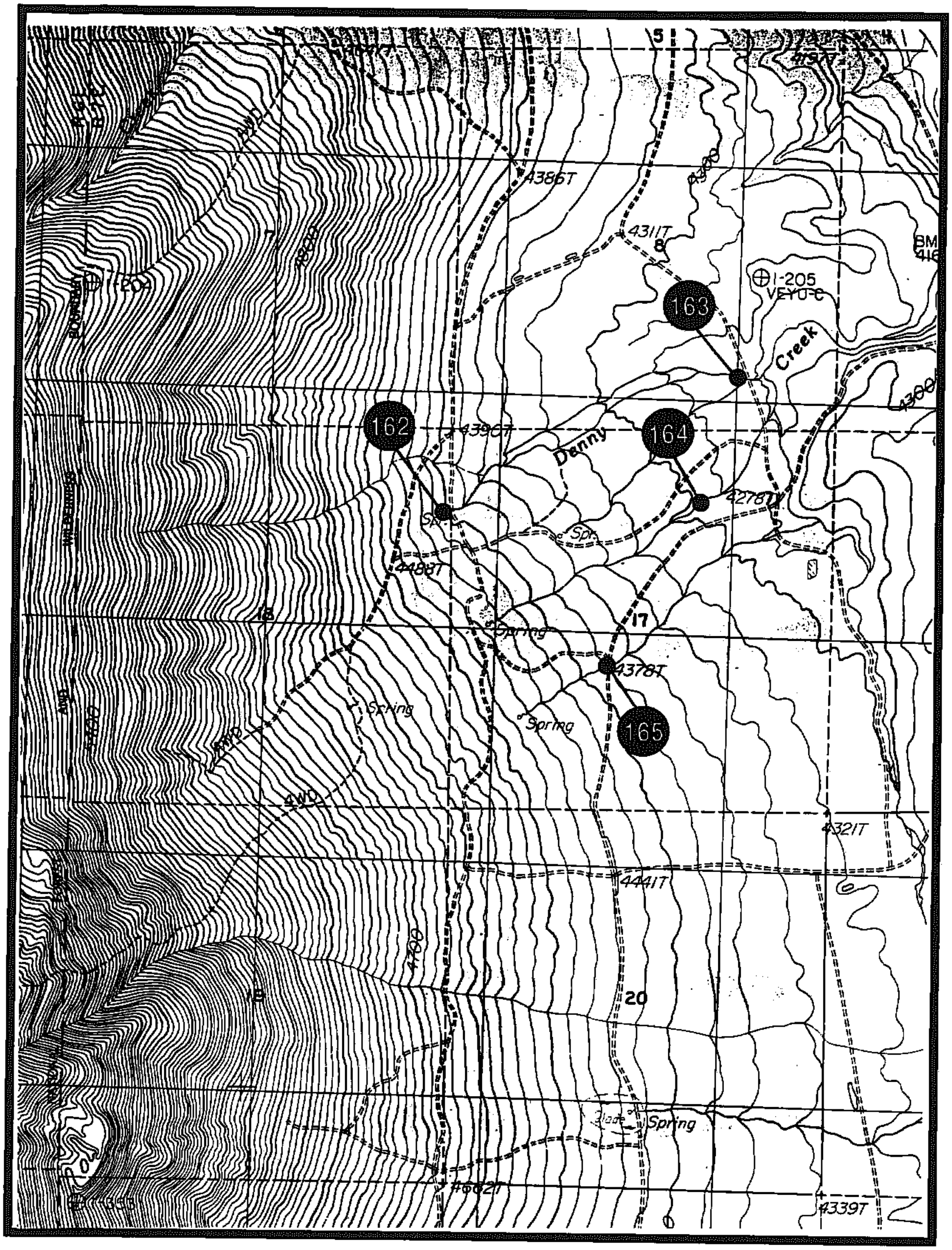
J



ARKANSAS FLAT QUADRANGLE, LAKE CO., OR
SITES 261, 262, 263, 264, 265, 266, 267, 268 = Ø

B11

4212231

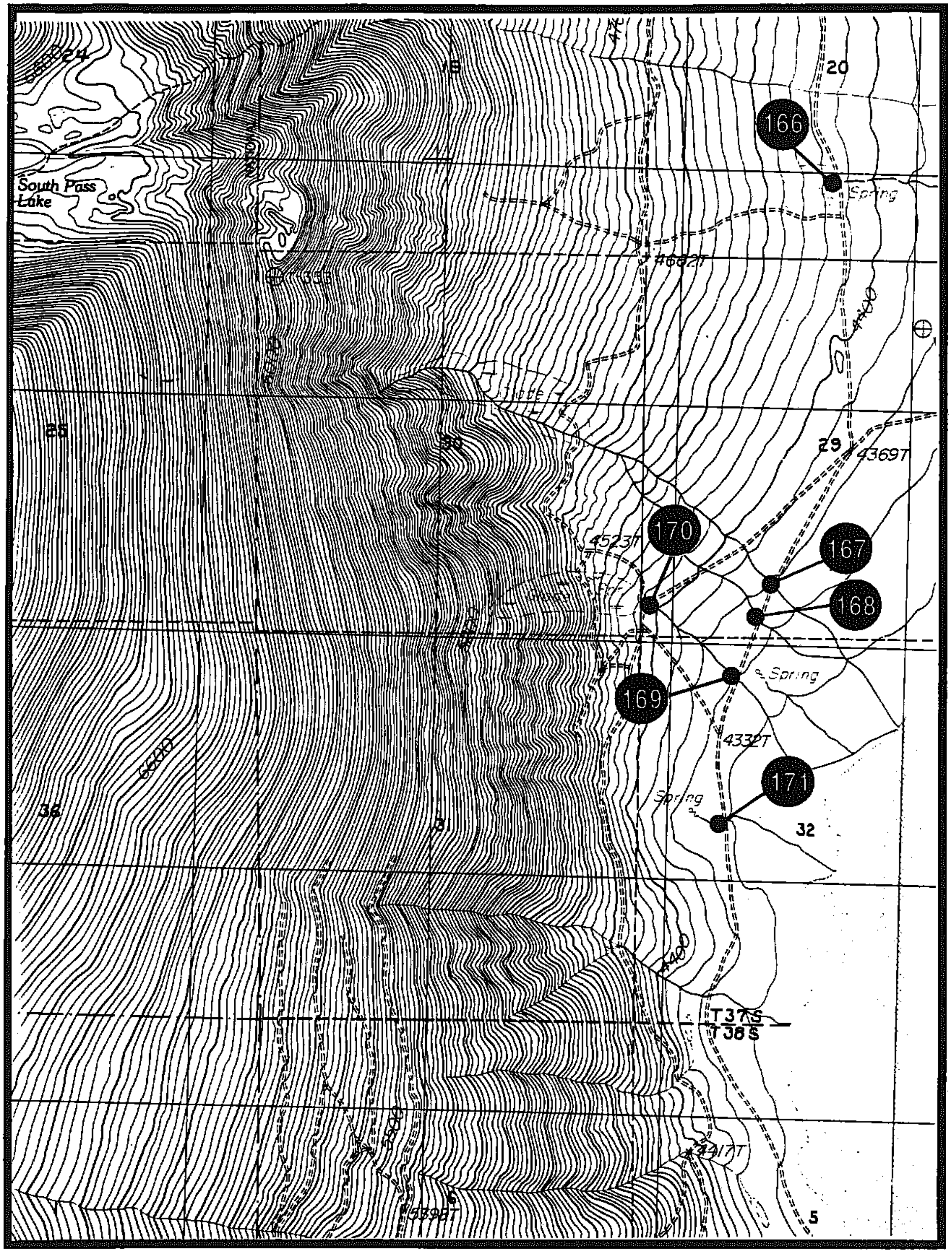


ASPEN LAKE QUADRANGLE, KLAMATH CO., OR
SITES 162, 163, 164, 165

162 = tiger .013

B12

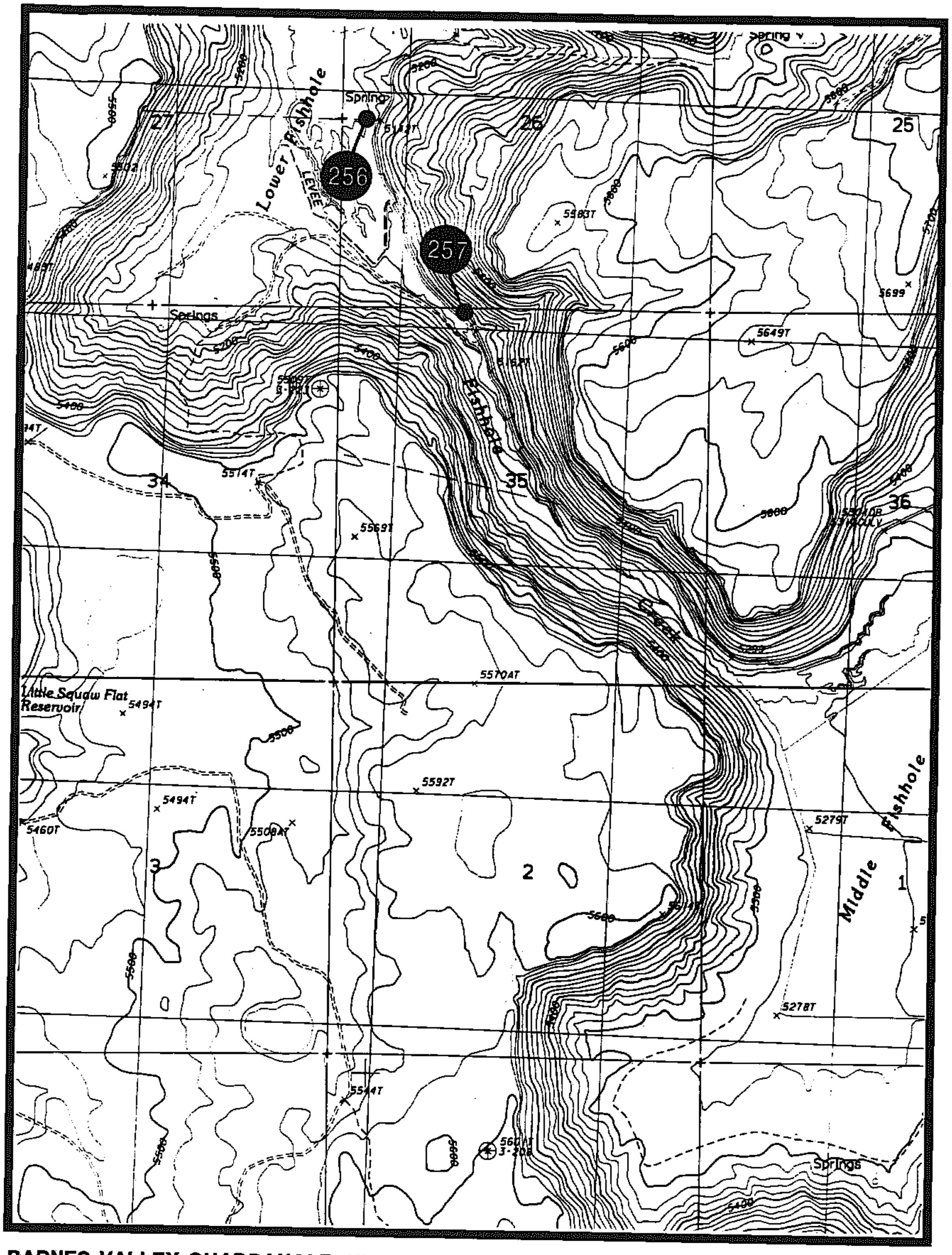
163 - 165 = φ



ASPEN LAKE QUADRANGLE, KLAMATH CO., OR
SITES 166, 167, 168, 169, 170, 171 = Ø

B13

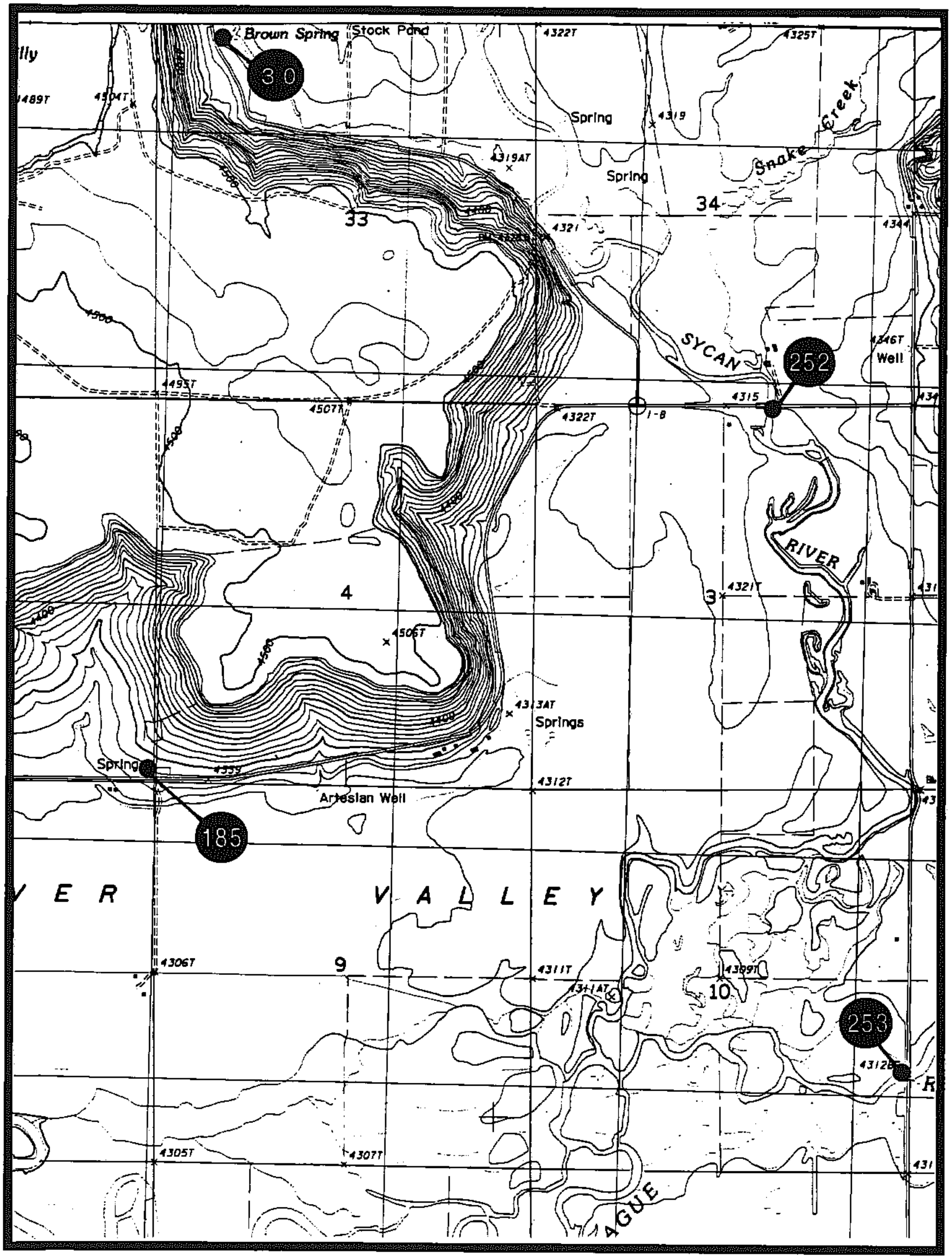
4212028 √



BARNES VALLEY QUADRANGLE, KLAMATH & LAKE COS., OR
SITES 256, 257 = φ

B14

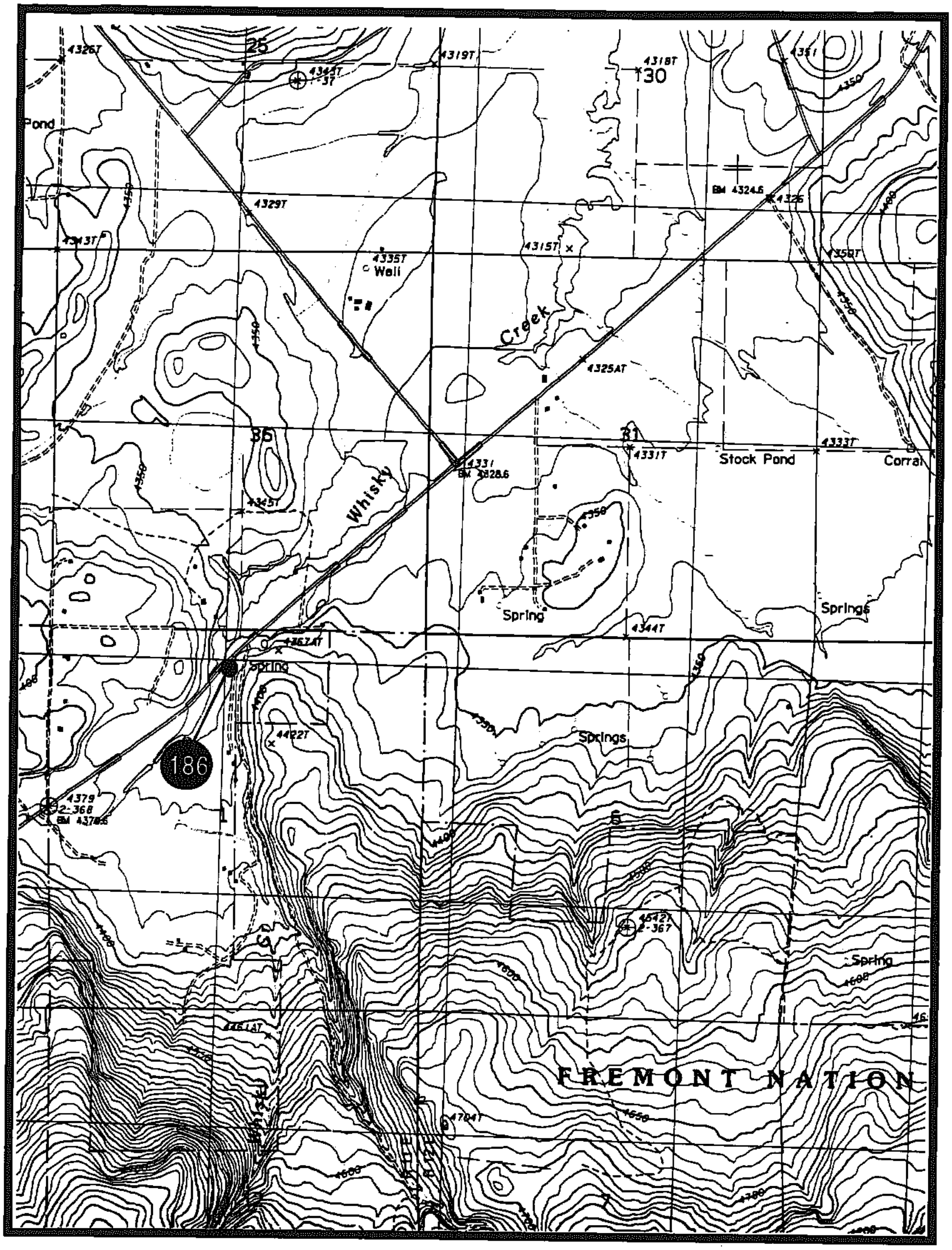
4212143



BEATTY QUADRANGLE, KLAMATH CO., OR
SITES 30, 185, 252, 253

site 30 = casebeer .001
site 252 = ∅
site 185 = ∅
site 253 = ∅

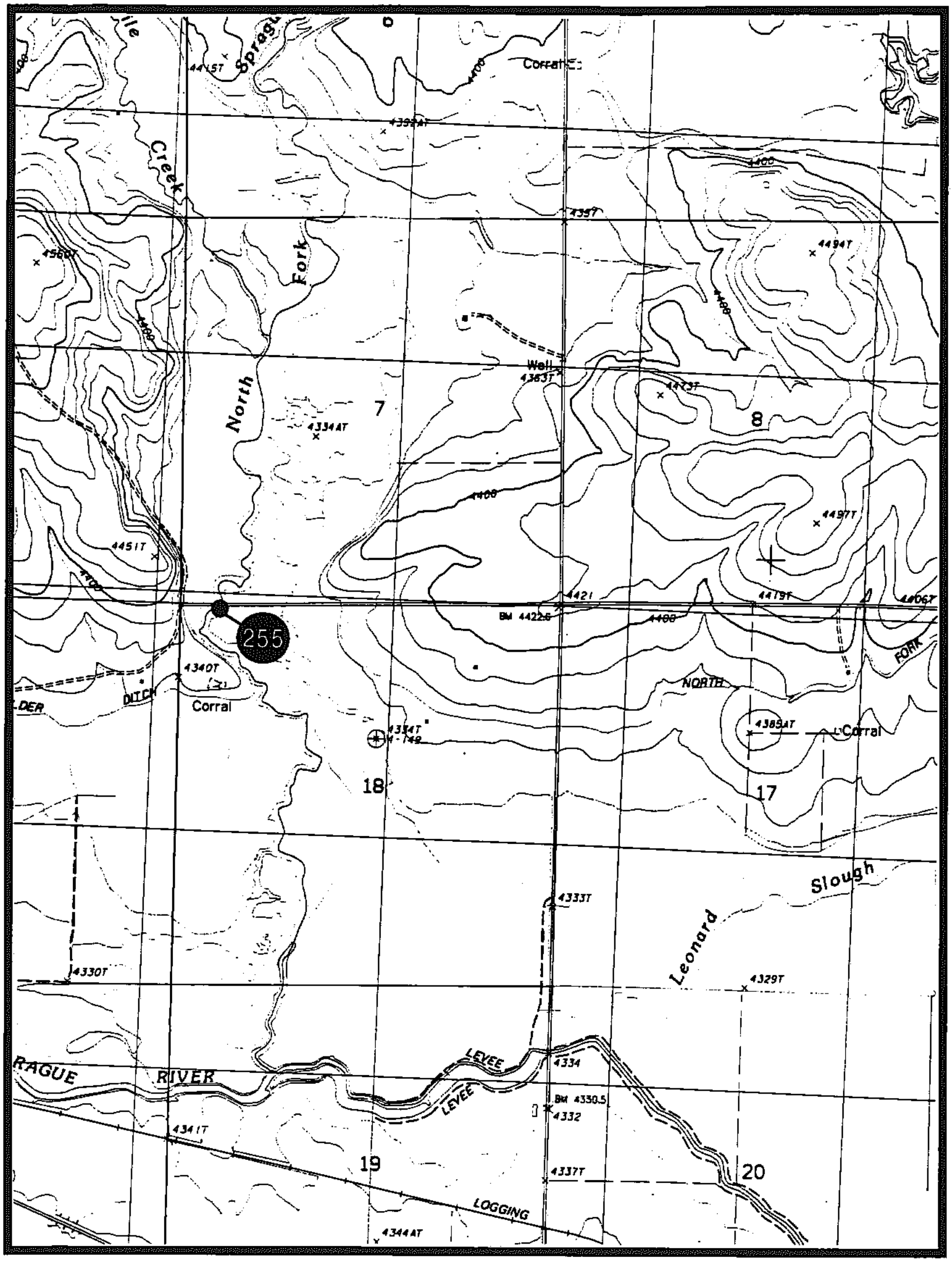
B15



BEATTY QUADRANGLE, KLAMATH CO., OR
SITES 186 = ∅

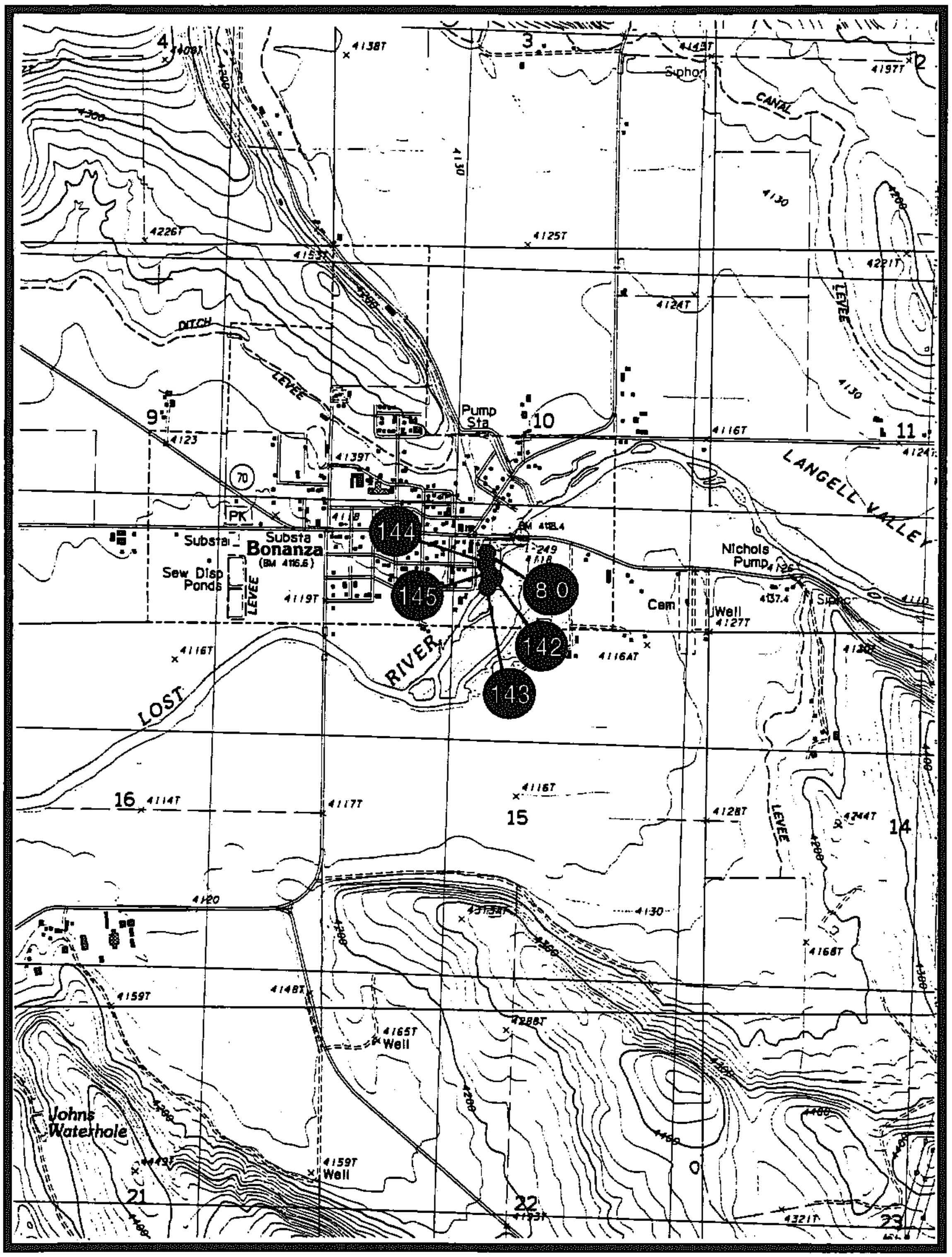
B16

42 12 41



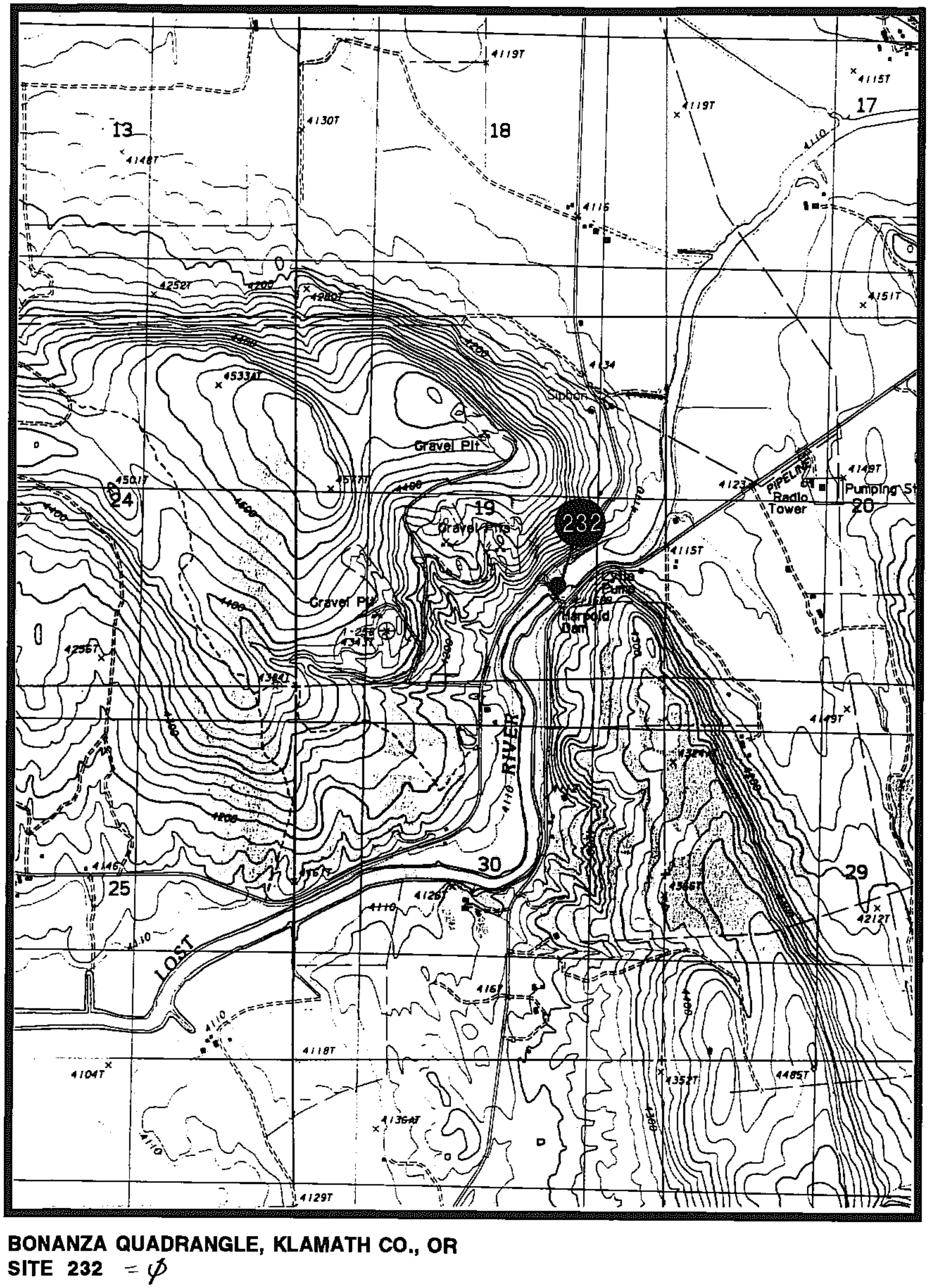
BLY QUADRANGLE, KLAMATH CO., OR
SITE 255 = ϕ

421 21 24



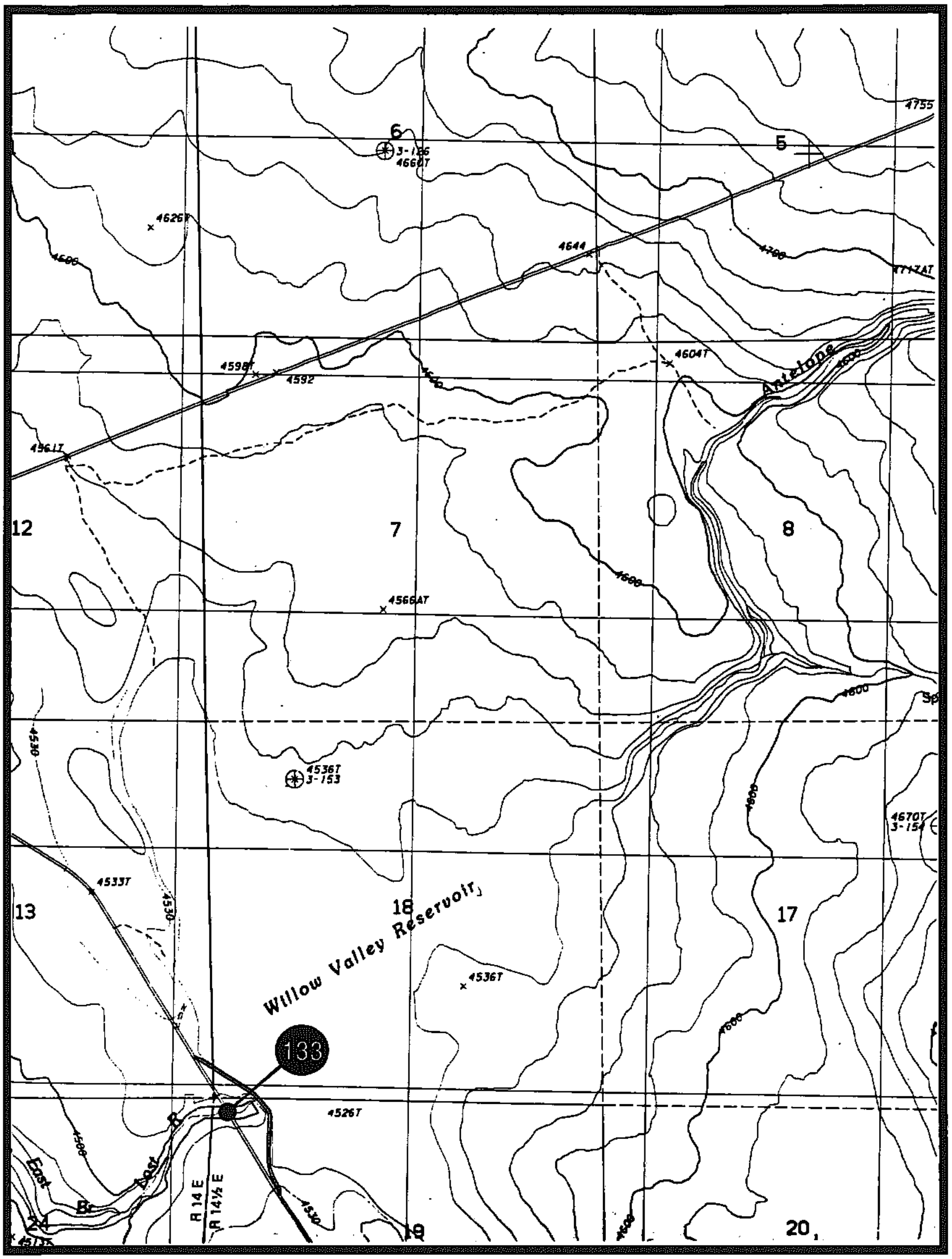
BONANZA QUADRANGLE, KLAMATH CO., OR
SITES 80, 142, 143, 144, 145

Site 144 = Lost river .001
(all others? so clumped) Lake of Woods .003 **B18**
Big spring springsnail .002



BONANZA QUADRANGLE, KLAMATH CO., OR
SITE 232 = ∅

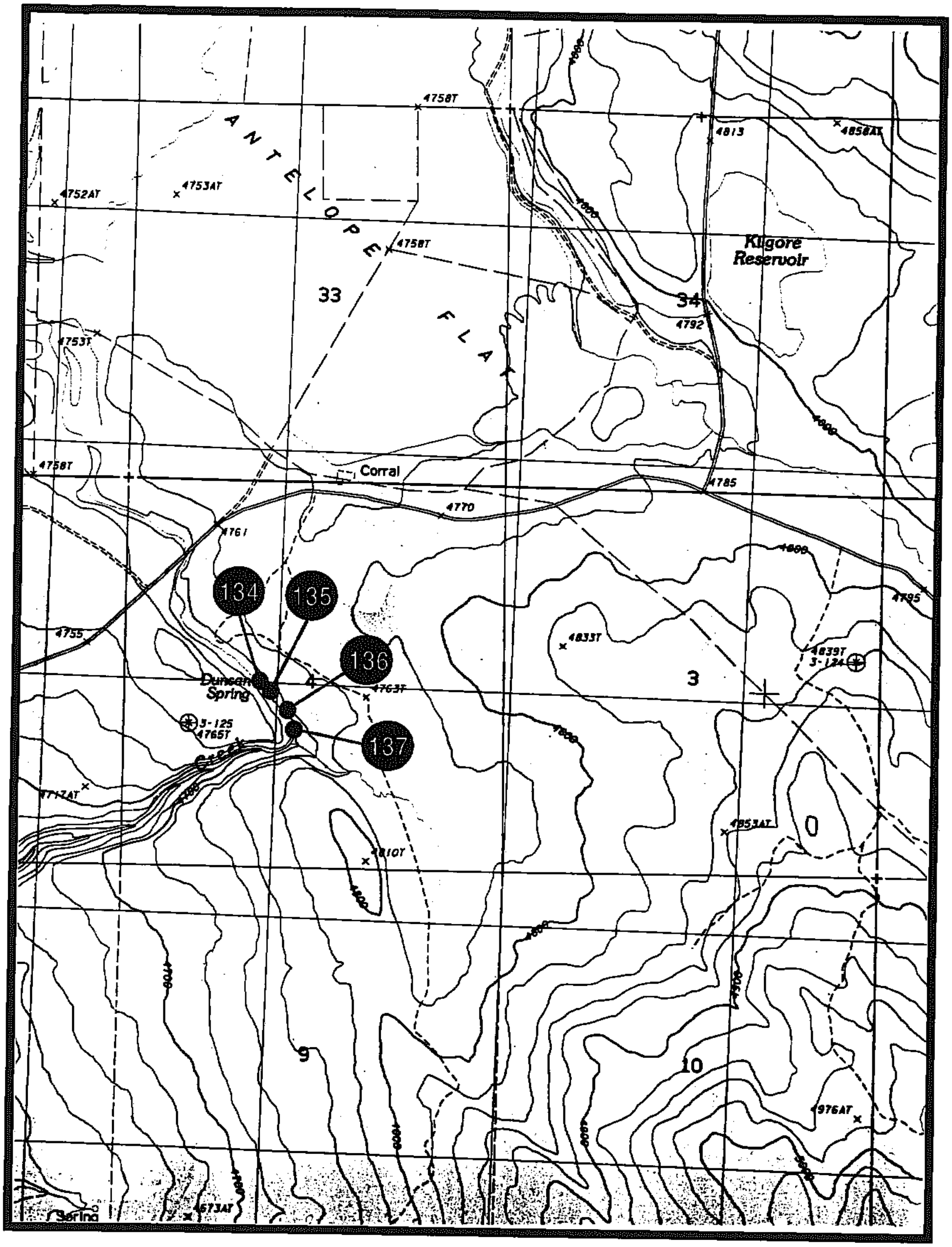
42121 11



BRADY BUTTE QUADRANGLE, KLAMATH CO., OR
SITE 133 = Ø

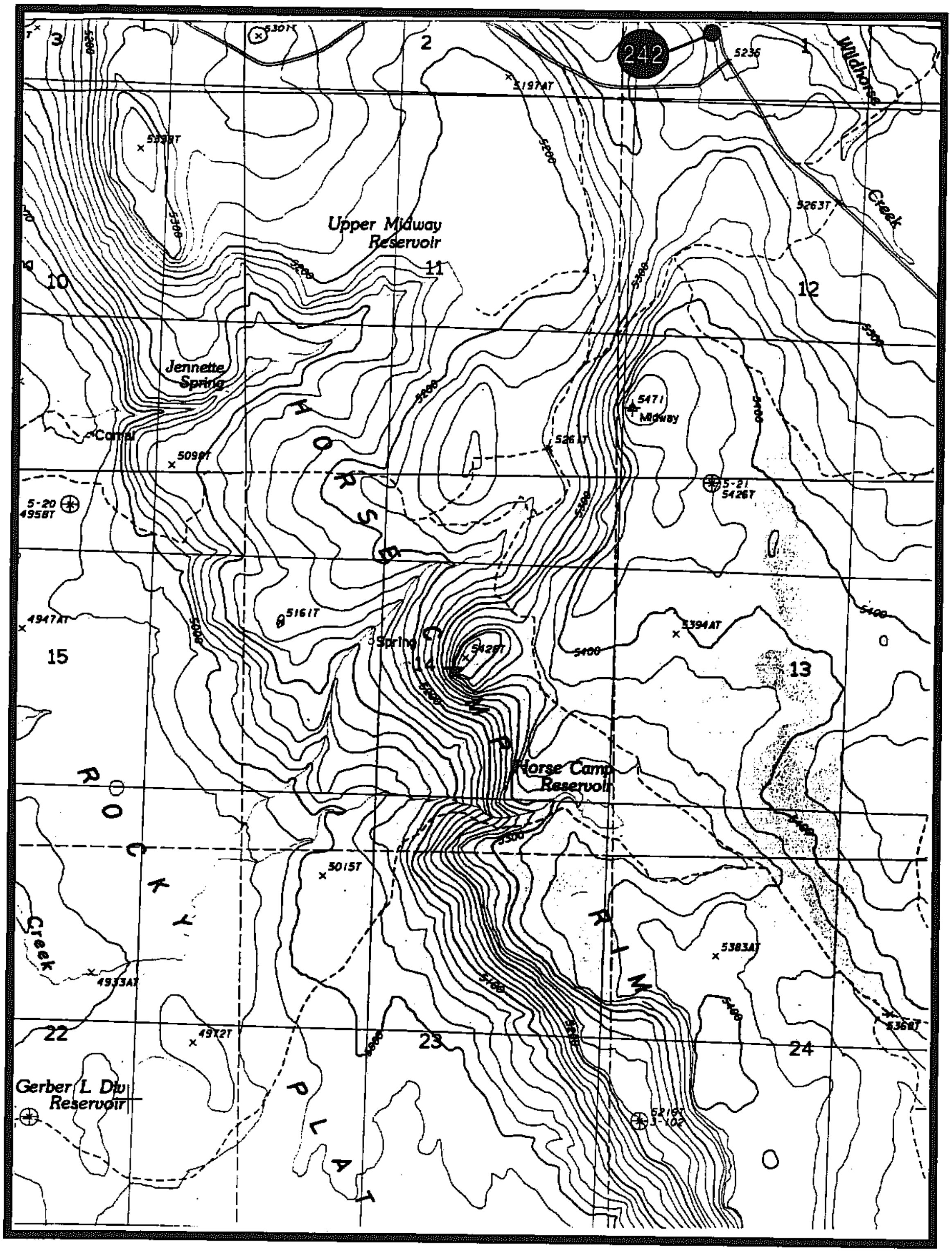
B20

J



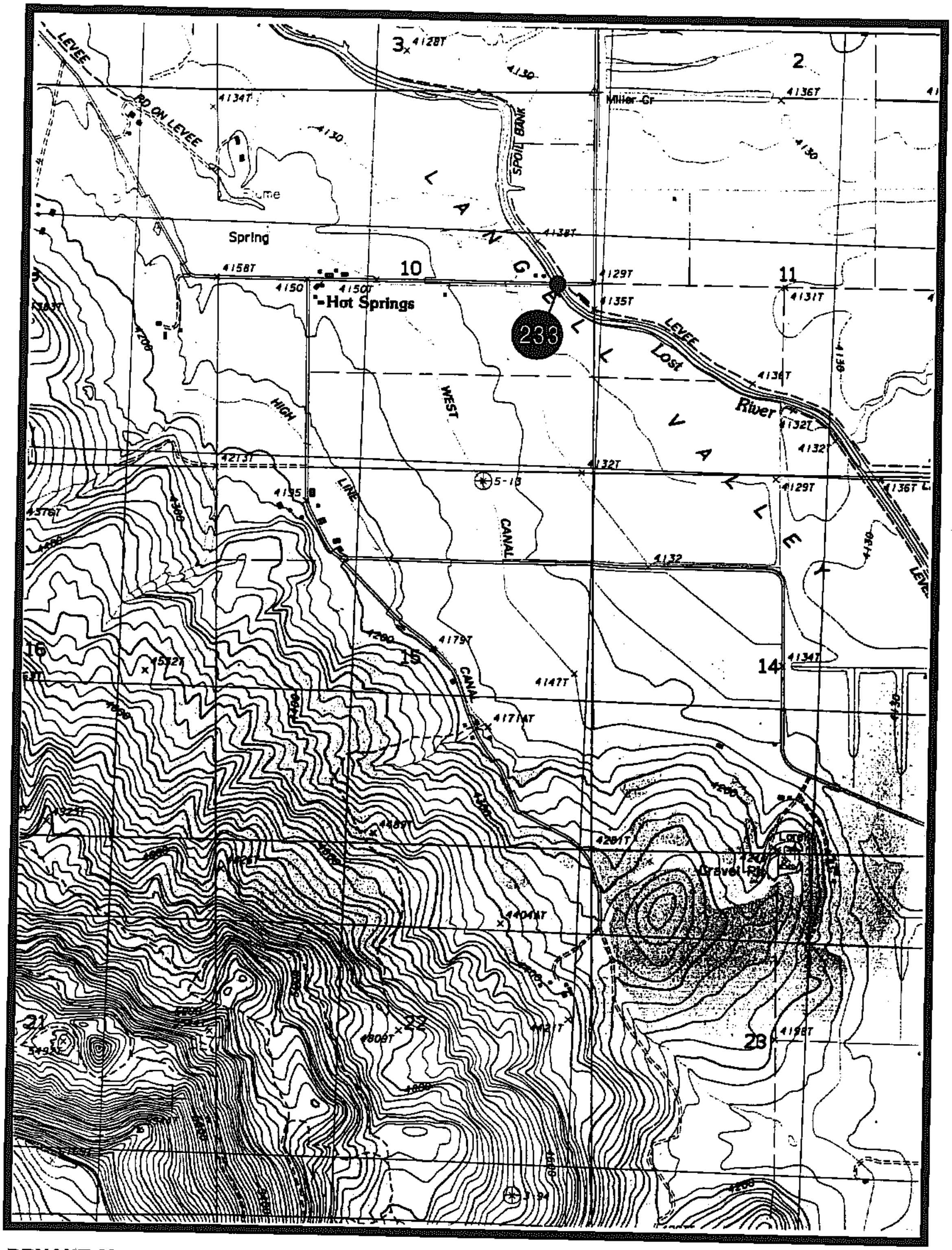
BRADY BUTTE QUADRANGLE, KLAMATH CO., OR
SITES 134, 135, 136, 137 ~ closely lumped
135 = Lake of the woods .007

B21



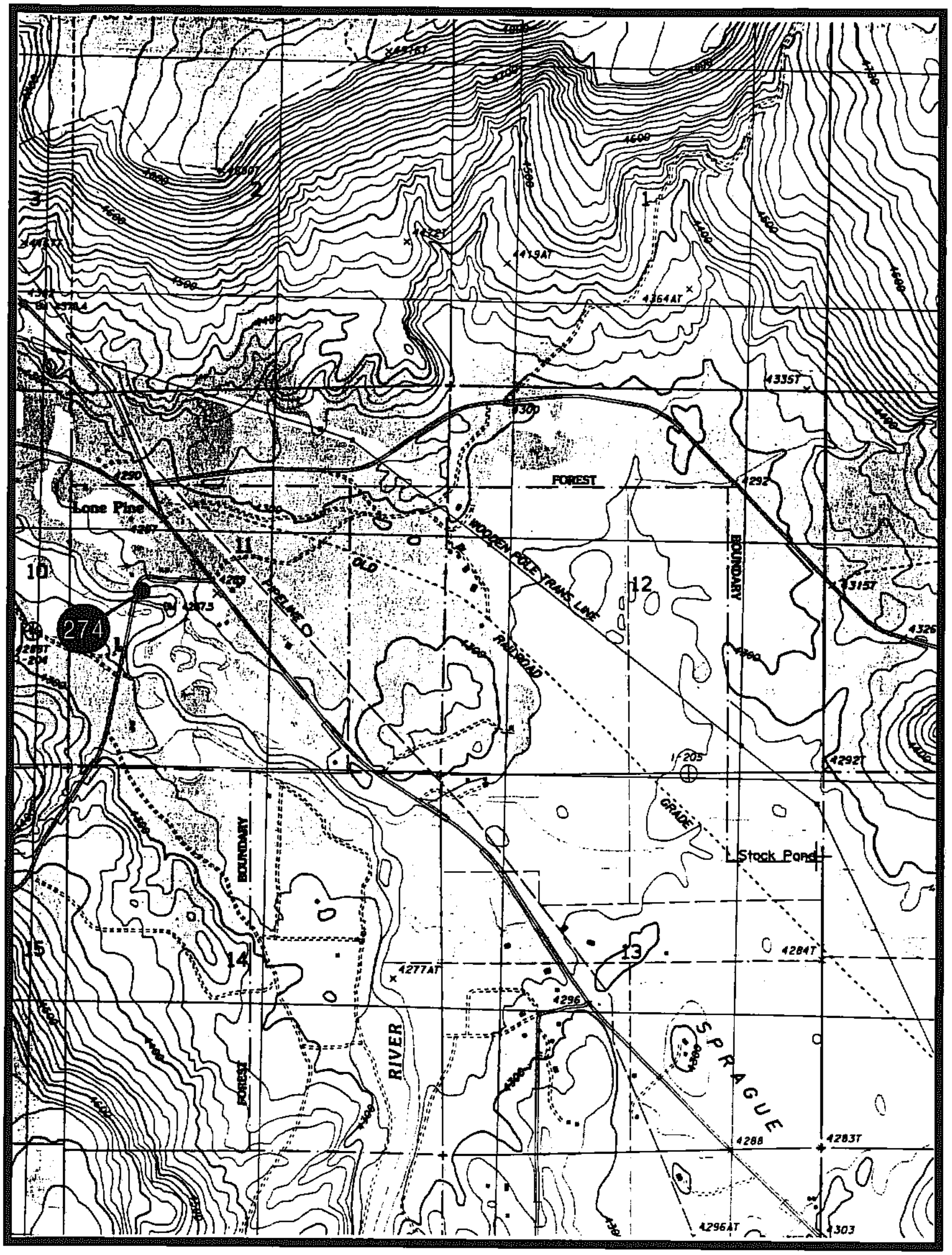
BRADY BUTTE QUADRANGLE, KLAMATH CO., OR
SITE 242 =∅

42121 13 J



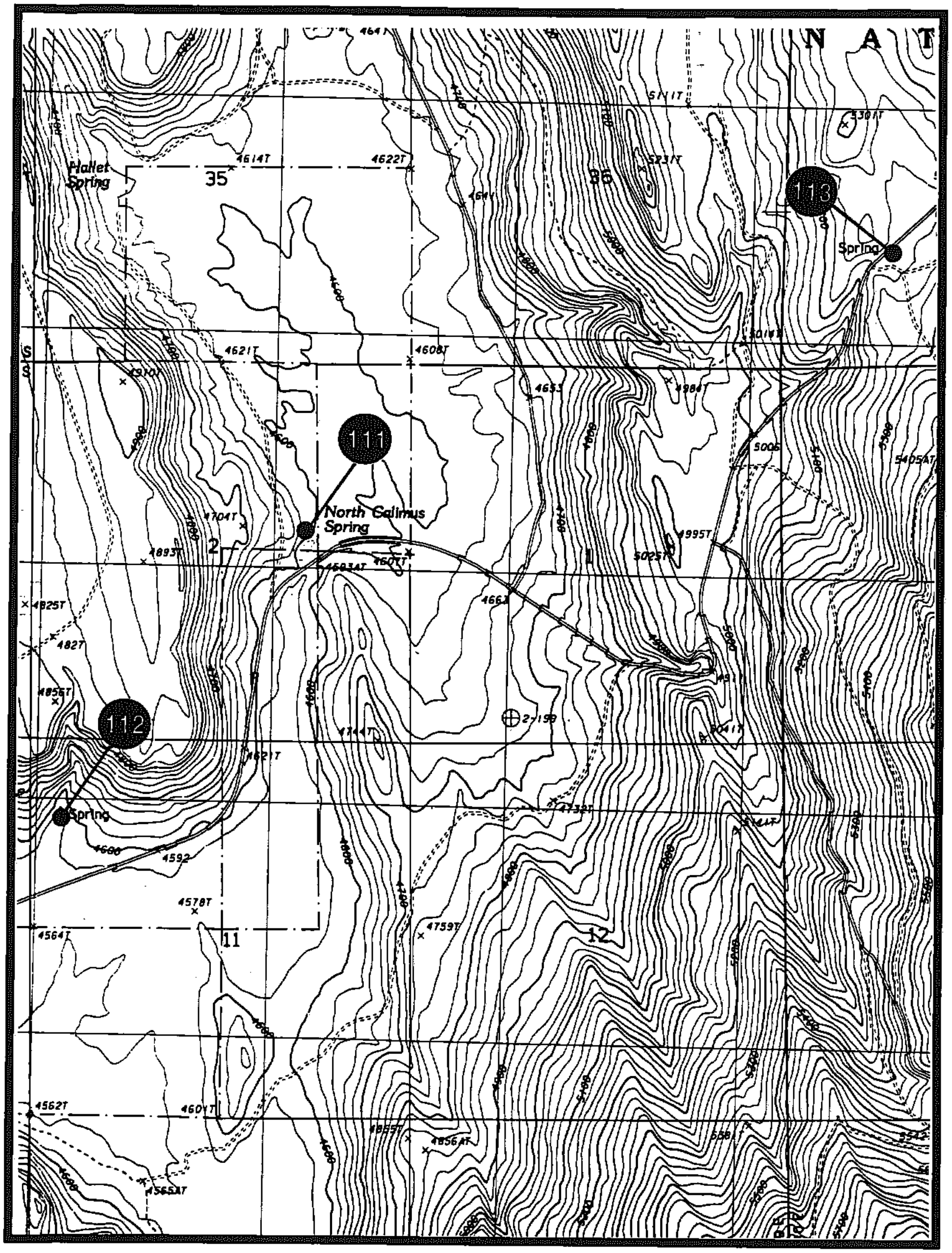
BRYANT MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITE 233 =ø

4212155 √



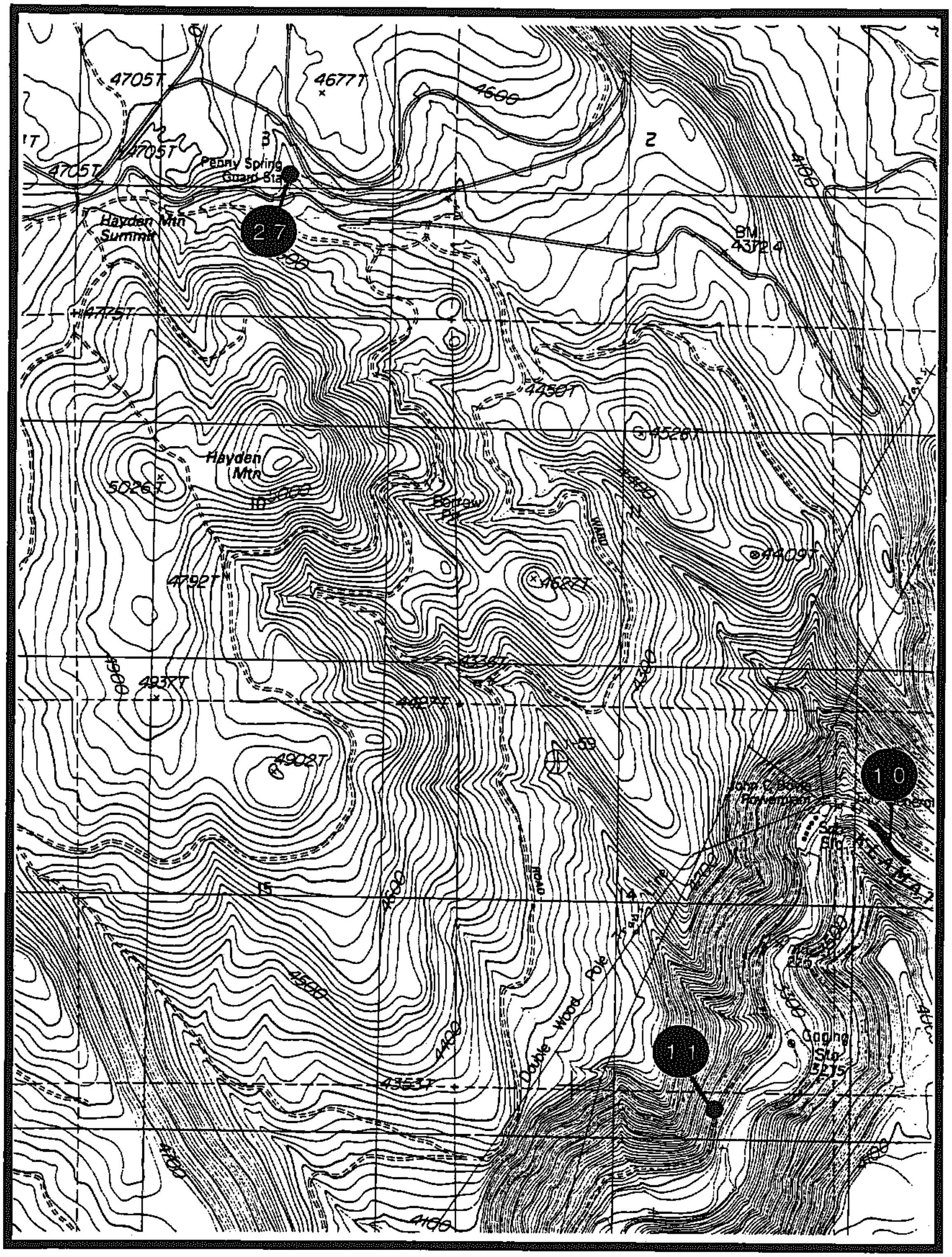
BUTTES OF THE GODS QUADRANGLE, KLAMATH CO., OR
SITE 274 = Ø

42 121 65



CALIMUS BUTTE QUADRANGLE, KLAMATH CO., OR
SITES 111, 112, 113 = φ

42 12211 √

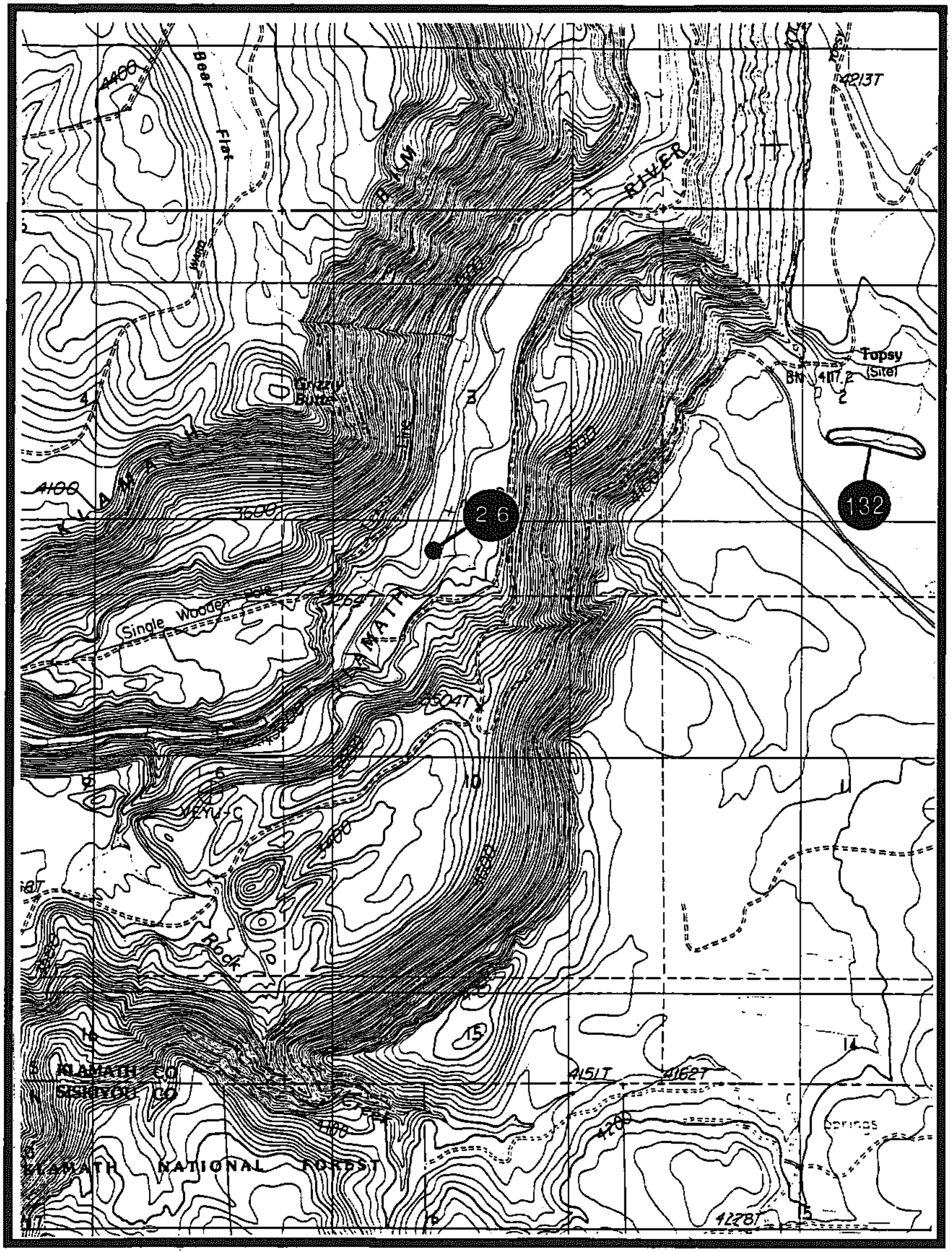


CHICKEN HILLS QUADRANGLE, KLAMATH CO., OR
SITES 10, 11, 27

10= Klamath .001

11, 27 = ∅

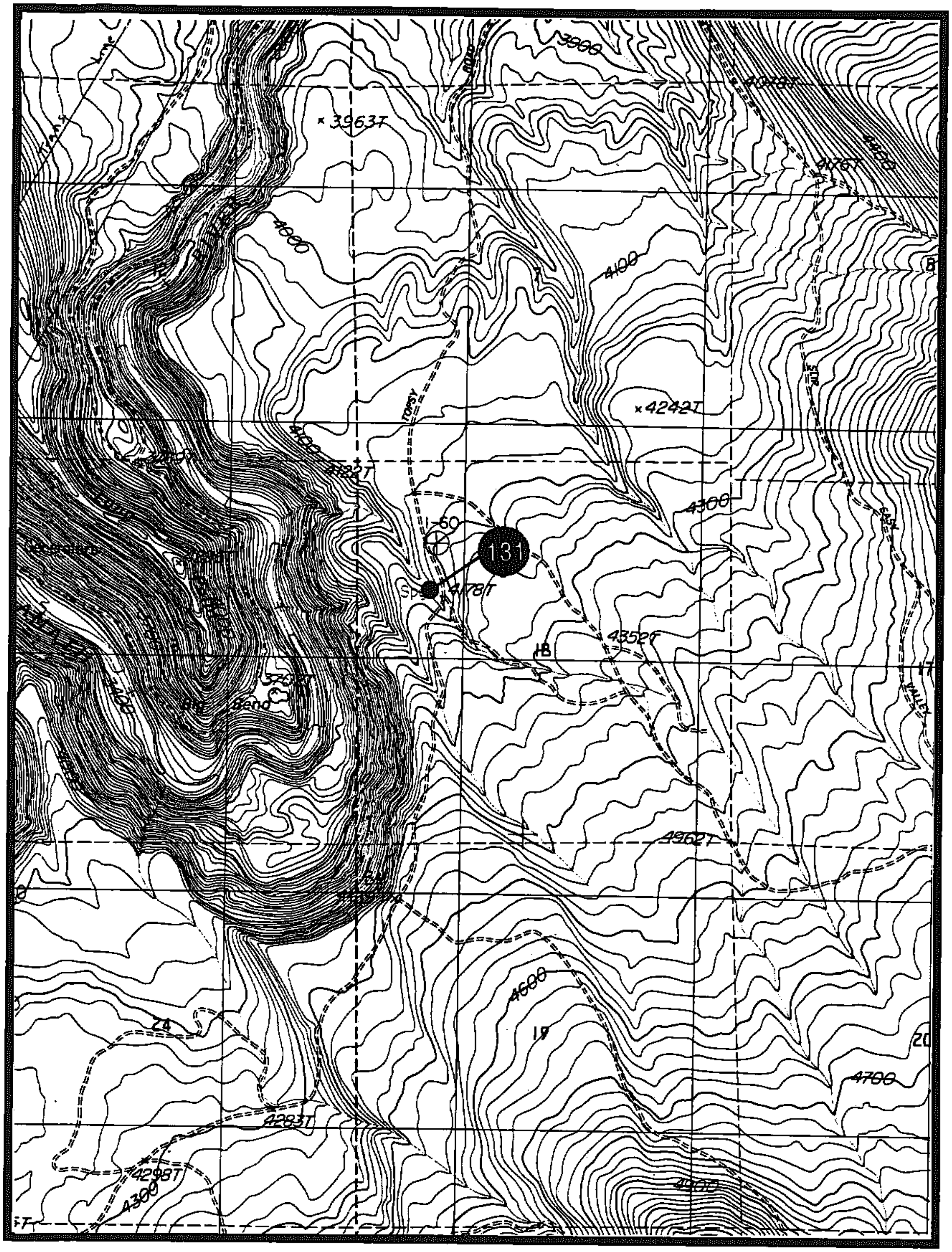
B26



CHICKEN HILLS QUADRANGLE, KLAMATH CO., OR
SITES 26, 132

26 = Lanx Kla .001
132 = ϕ

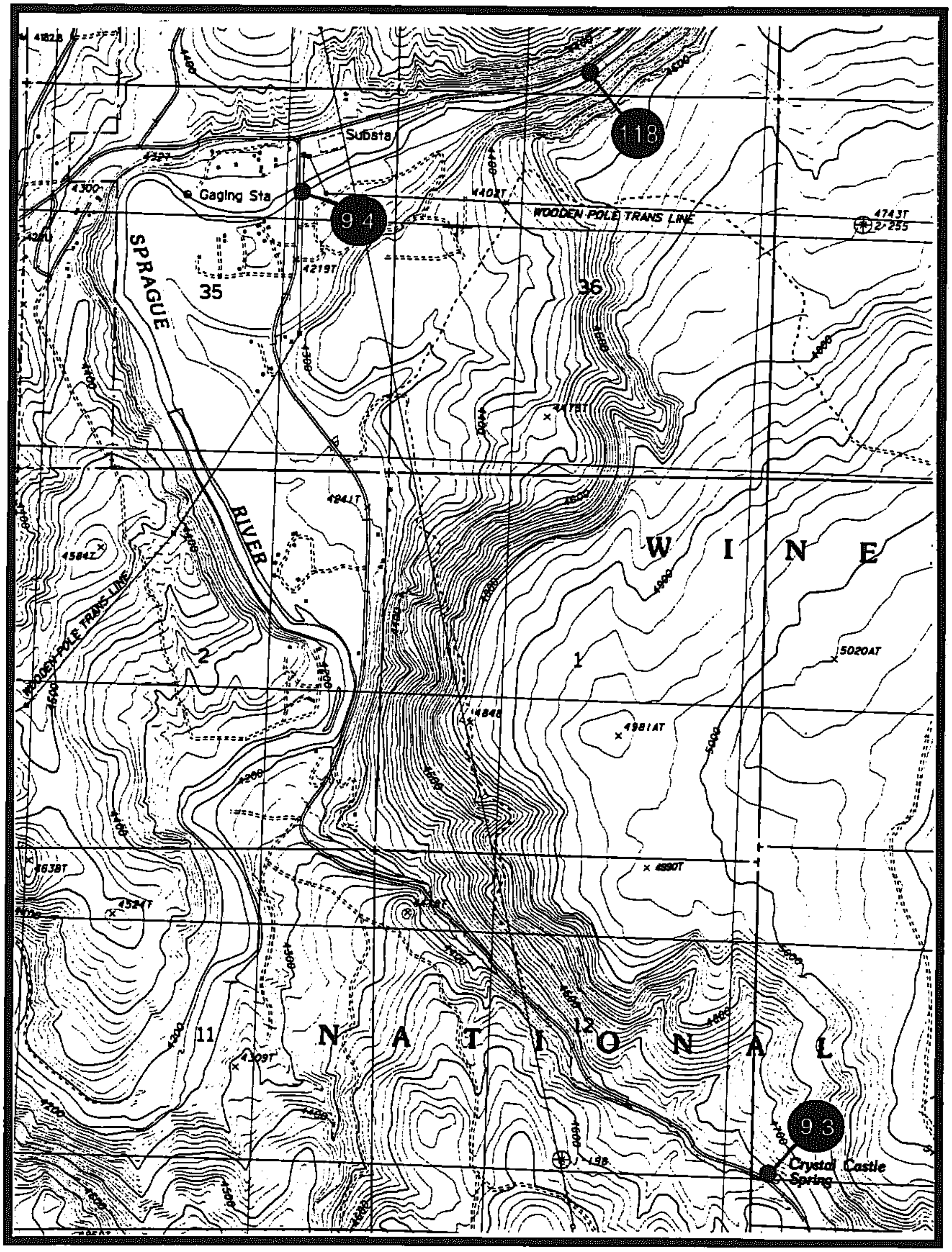
B27



CHICKEN HILLS QUADRANGLE, KLAMATH CO., OR
SITE 131

B28

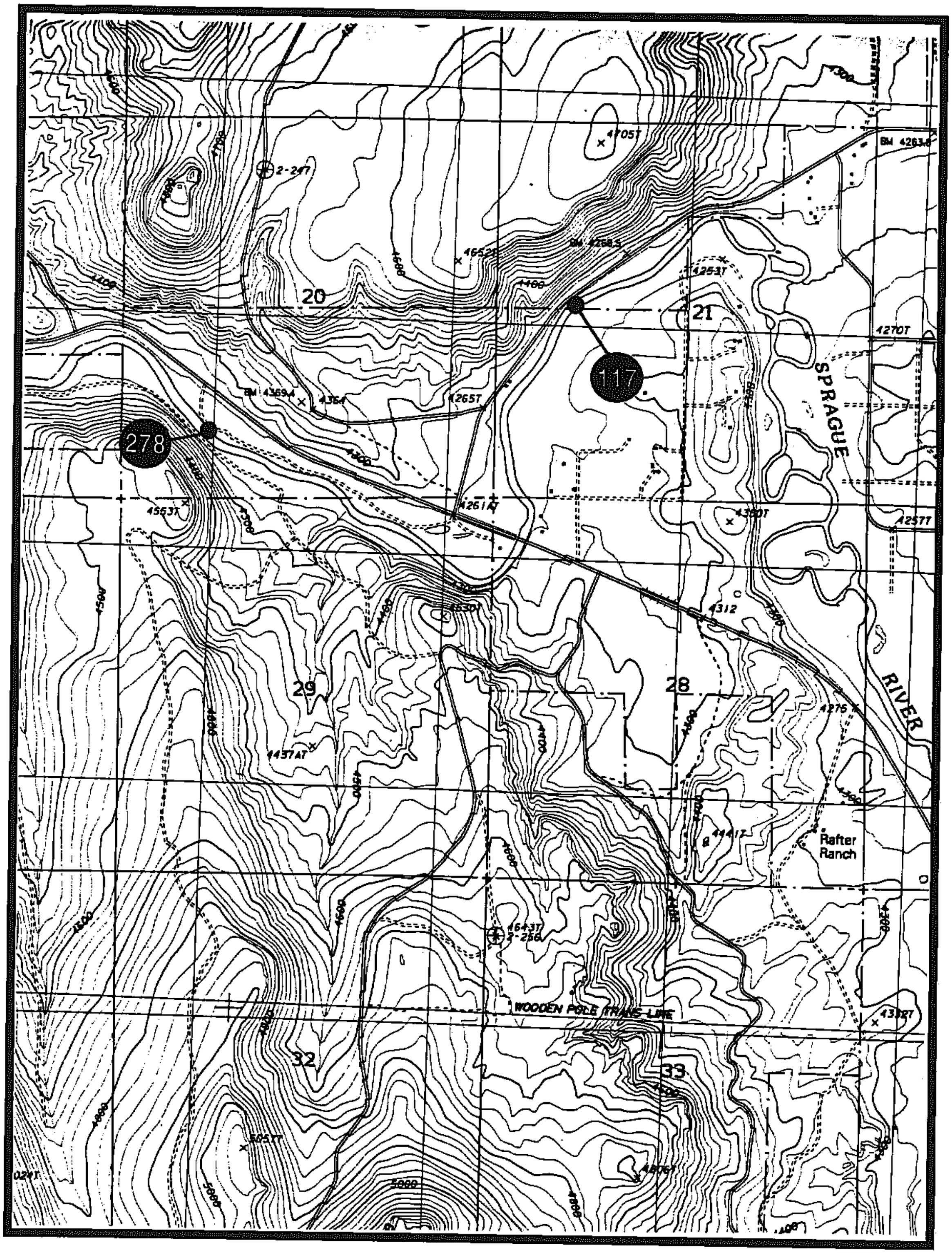
42 121 57 ✓



CHILOQUIN QUADRANGLE, KLAMATH CO., OR
SITES 93, 94, 118

94 = Klamath (Lygo...) .003
93 = Ø
118 = Crooked creek .019
Lanx alta .004

B29

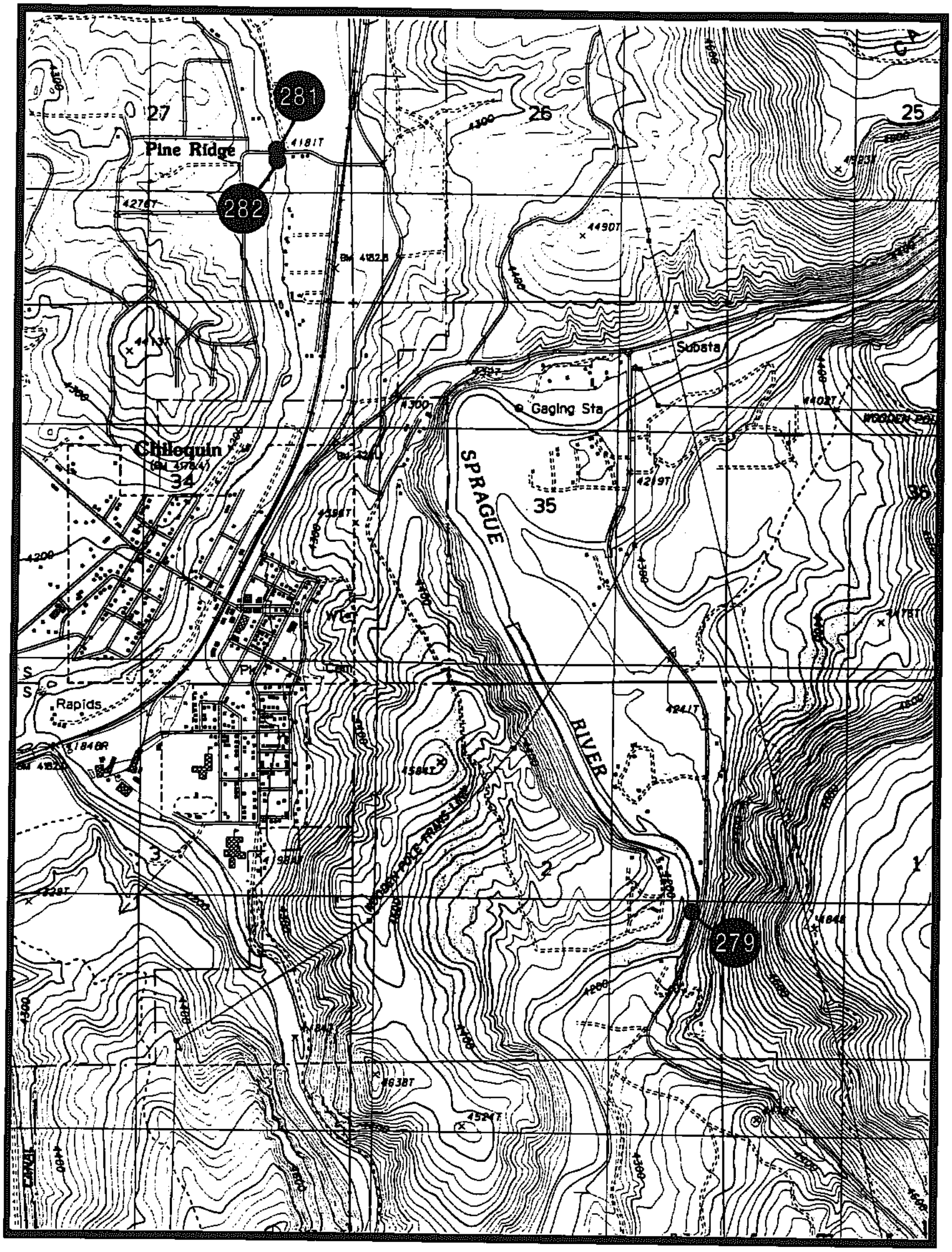


CHILOQUIN QUADRANGLE, KLAMATH CO., OR
SITES 117, 278

278 = φ

117 = Klamath peb. .008
crooked creek .018

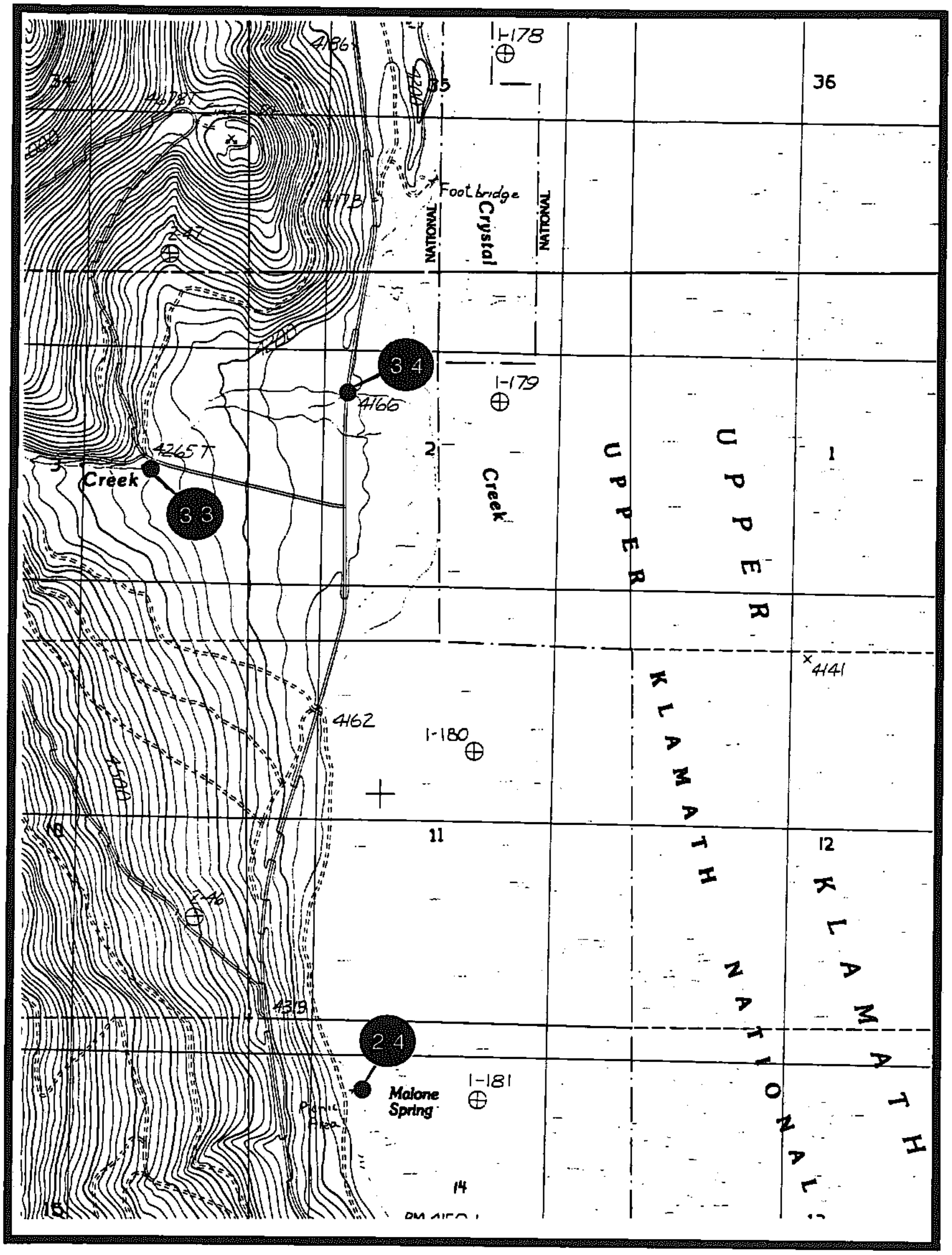
B30



CHILOQUIN QUADRANGLE, KLAMATH CO., OR
SITES 279, 281, 282 = Ø

B31

42122 51



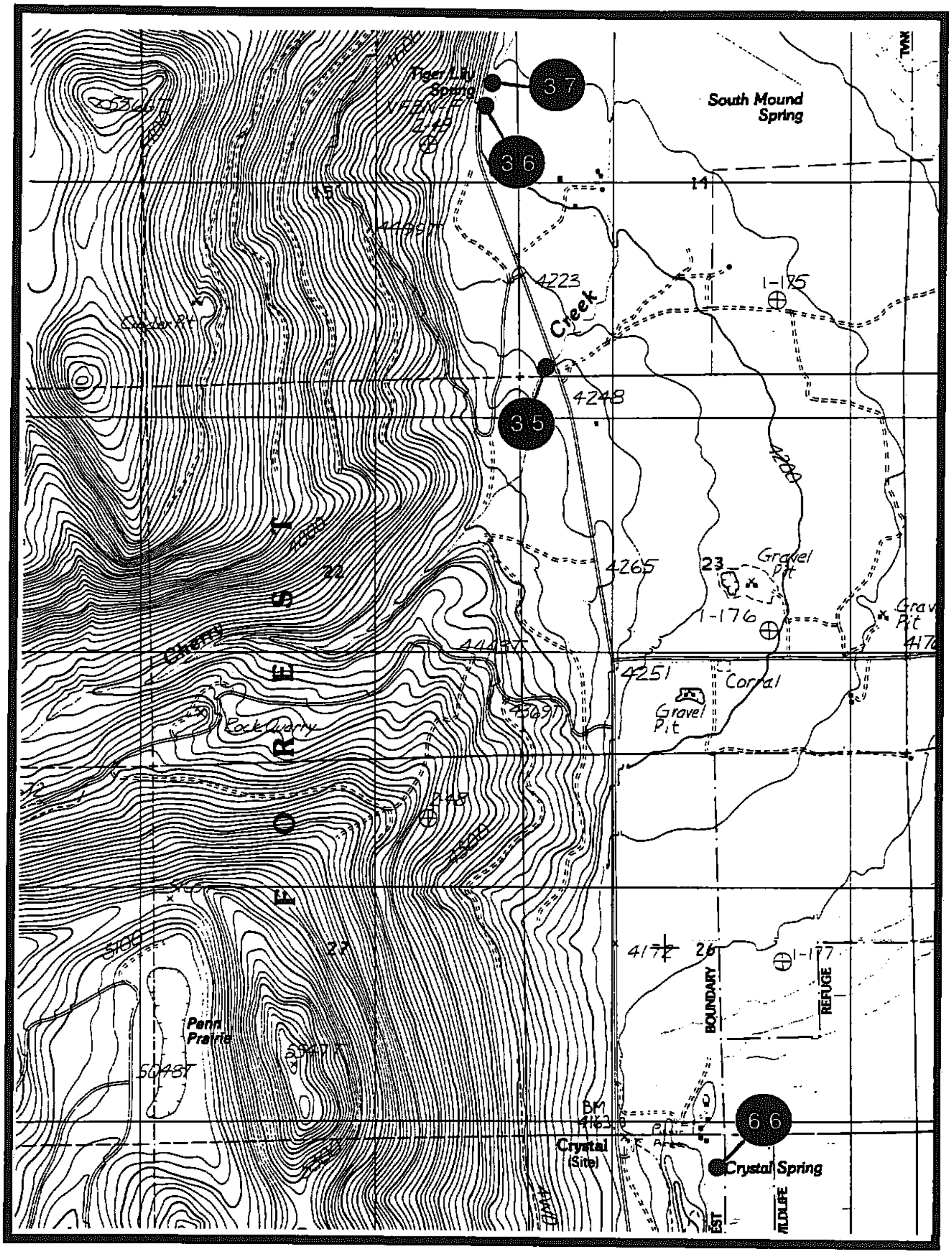
CRYSTAL SPRING QUADRANGLE, KLAMATH CO., OR
SITES 24, 33, 34

33, 34 = ϕ

24 = Klamath .003
lanx Kla .006
mares .005

B32

✓



CRYSTAL SPRING QUADRANGLE, KLAMATH CO., OR
SITES 35, 36, 37, 66

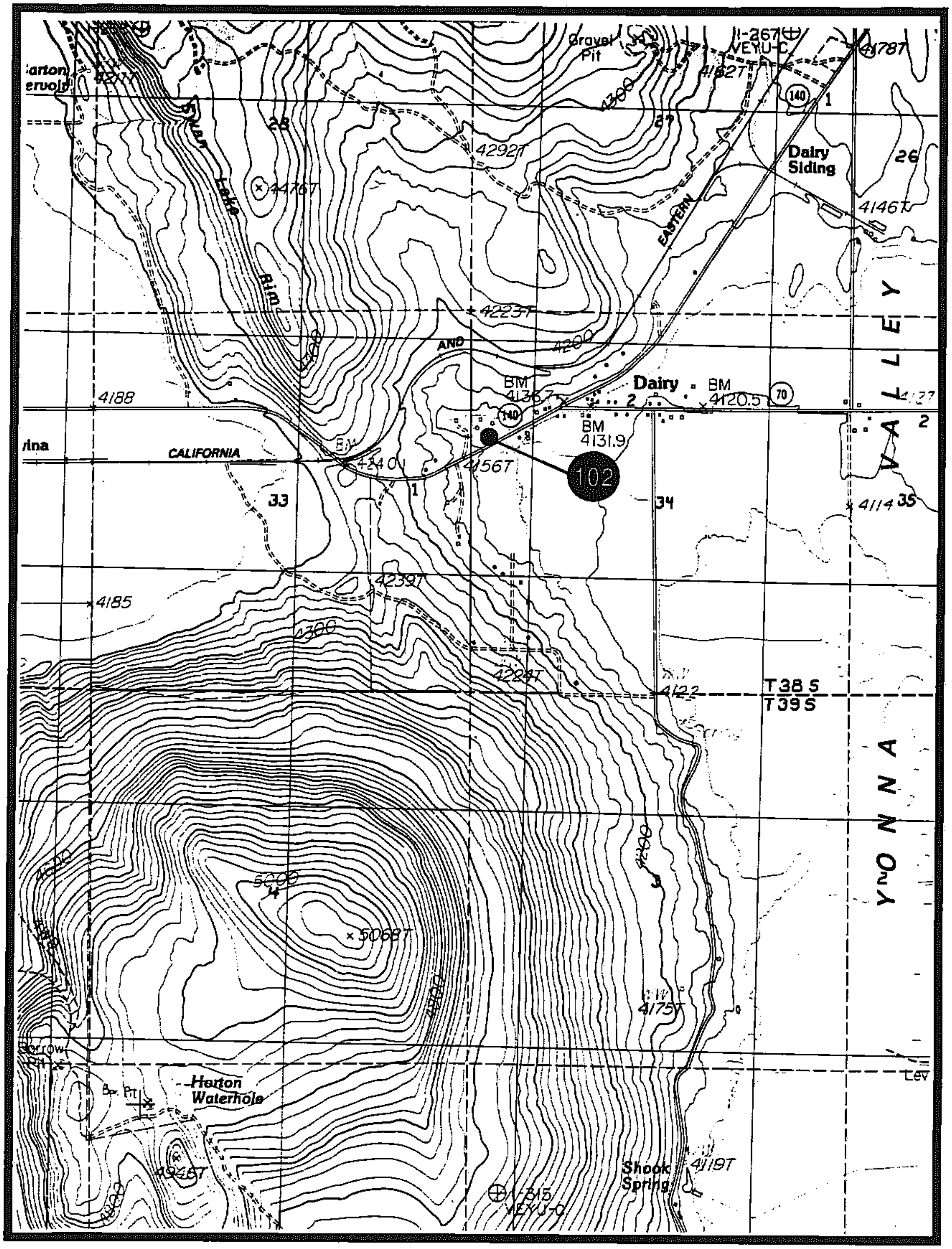
36 = Tiger .004

35 = ϕ
37 = ϕ (or combine w/ 36)

B33

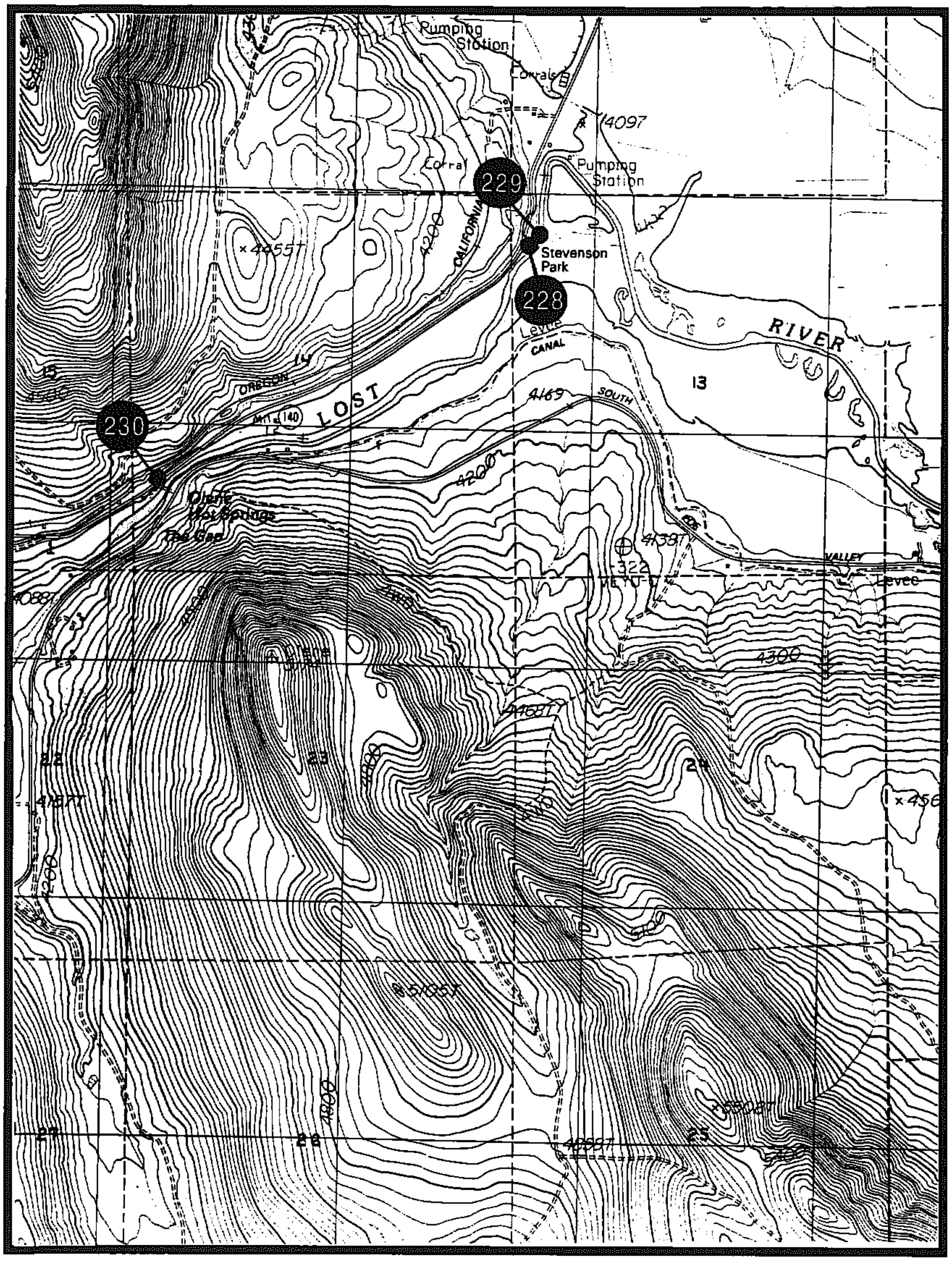
66 = Klamath .005
tiger .006
mares .007

42 121 25



DAIRY QUADRANGLE, KLAMATH CO., OR
SITE 102 = Ø

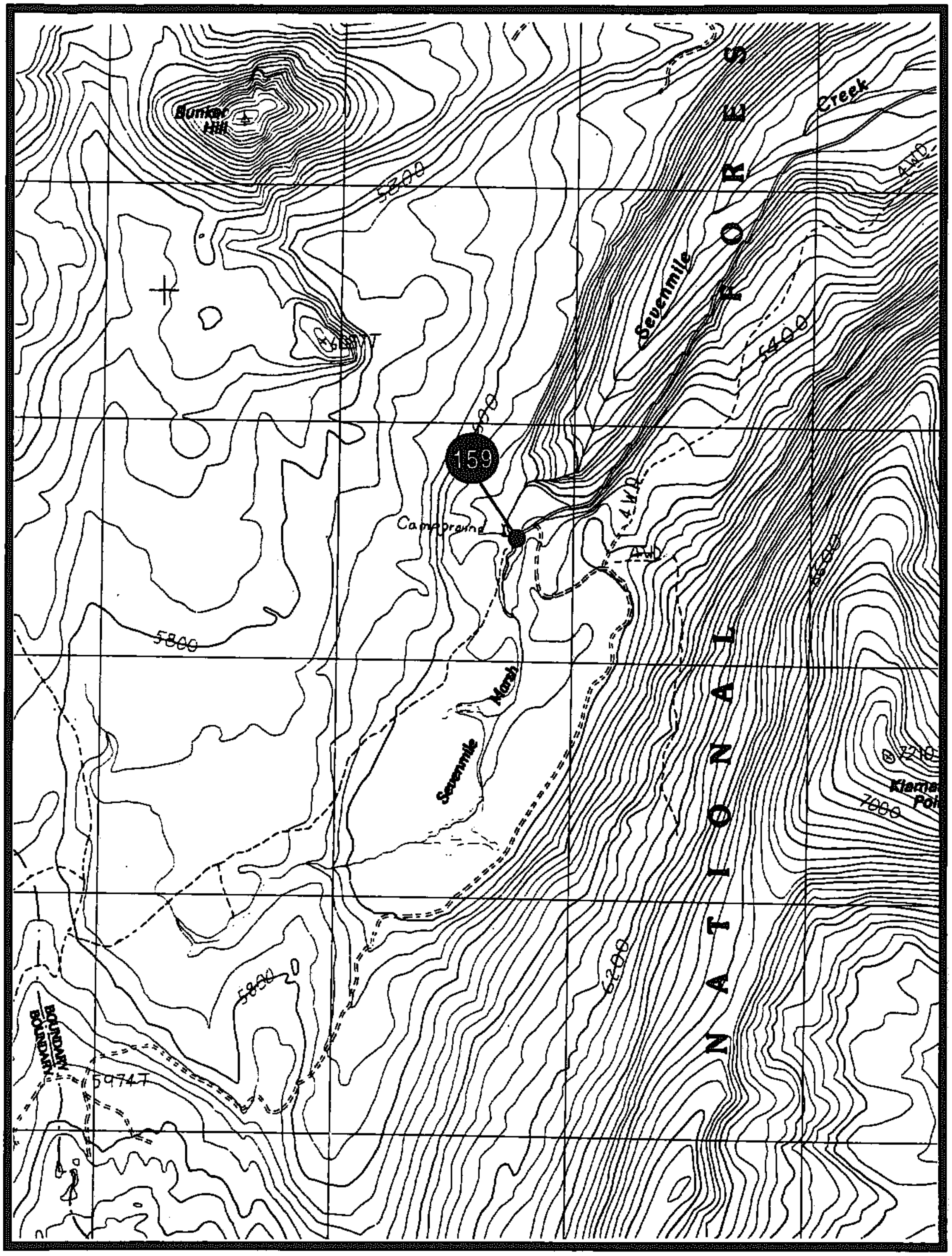
√



DAIRY QUADRANGLE, KLAMATH CO., OR
SITES 228, 229, 230 = ∅

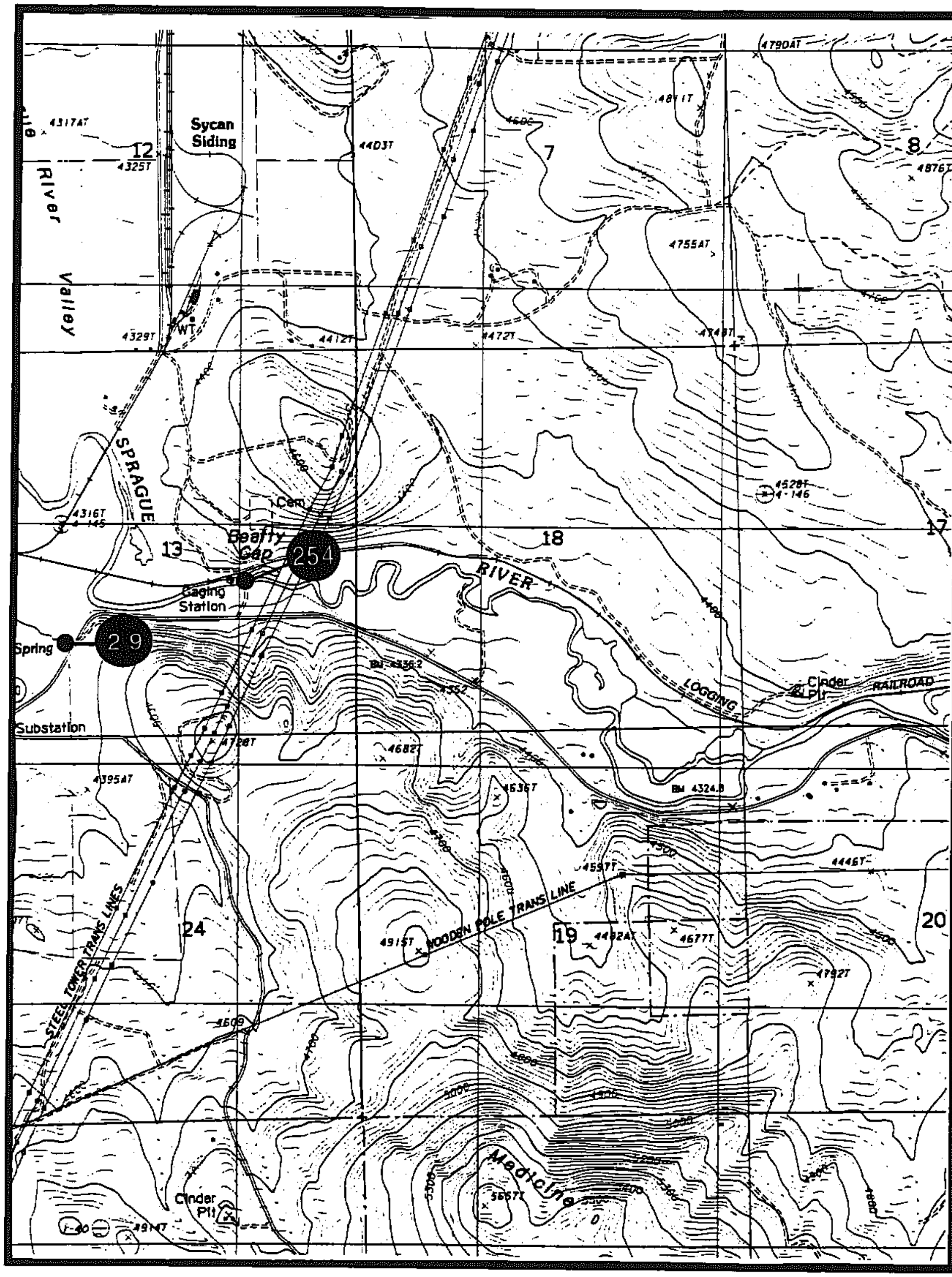
B35

4212262 ✓



DEVILS PEAK QUADRANGLE, KLAMATH CO., OR
SITE 159 = ∅

42 121 42



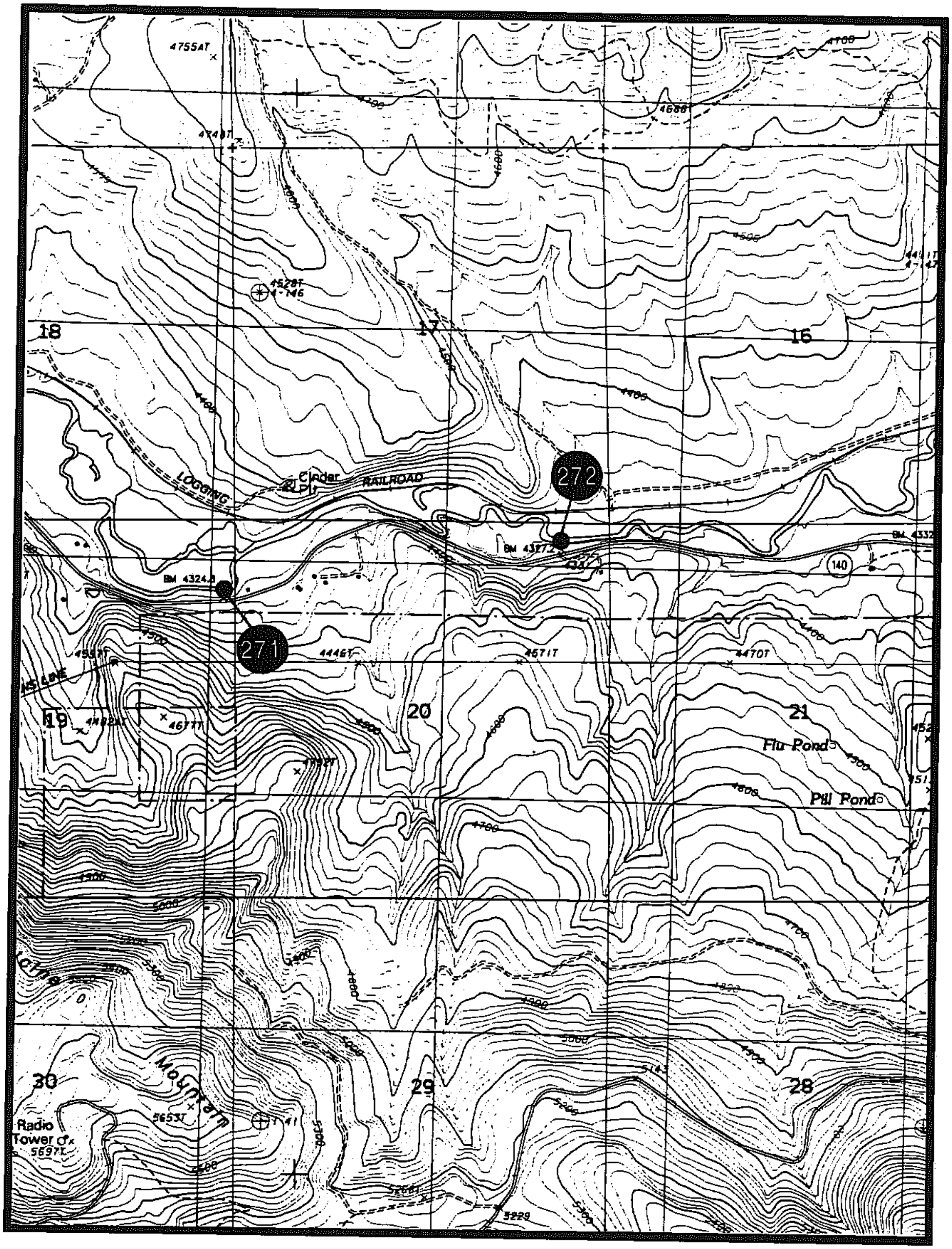
FERGUSON MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITES 29, 254

29 = Lake of Woods .002
Big spring springsnail

254 = ∅

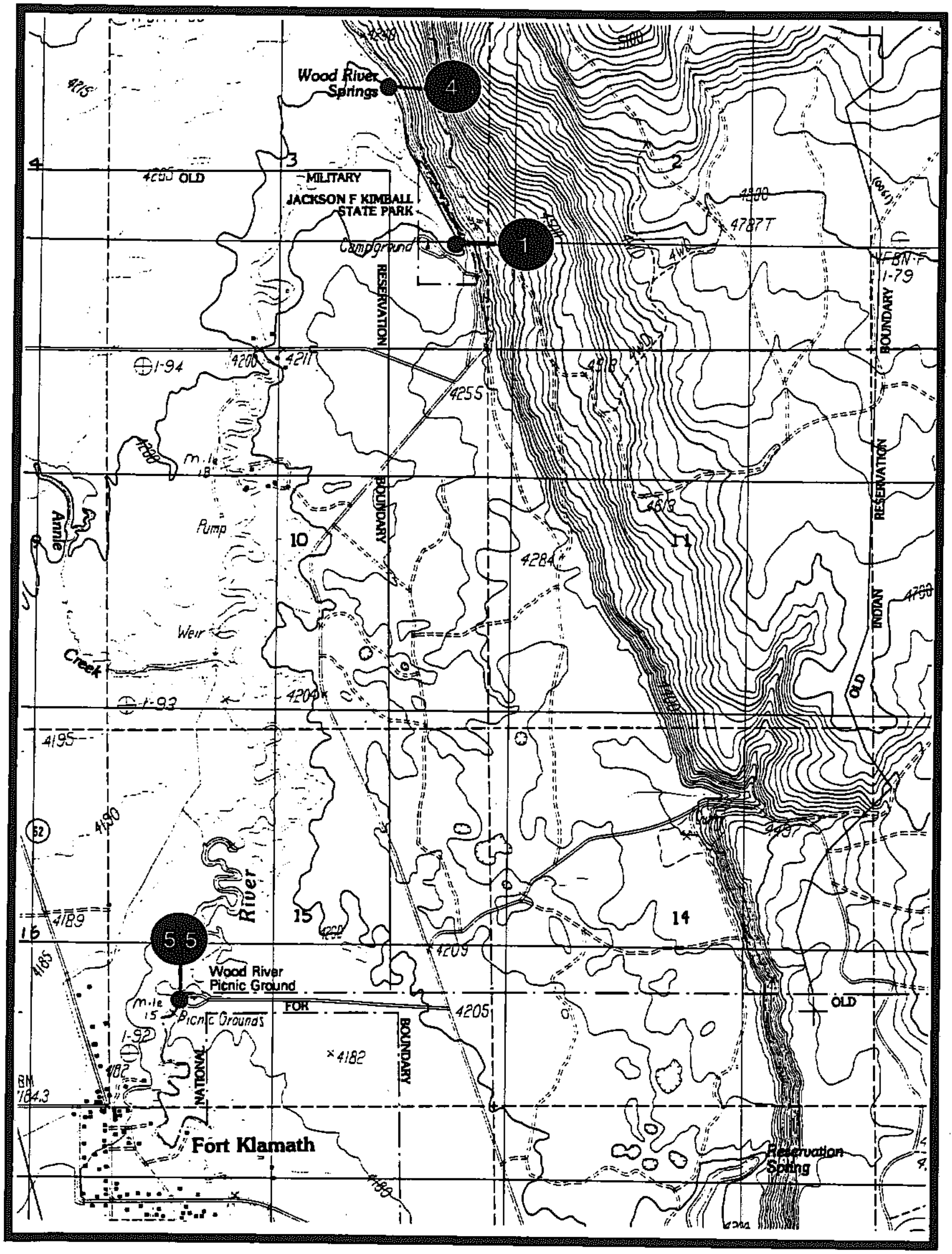
B37

✓



FERGUSON MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITES 271, 272 = φ

42 121 68 ✓

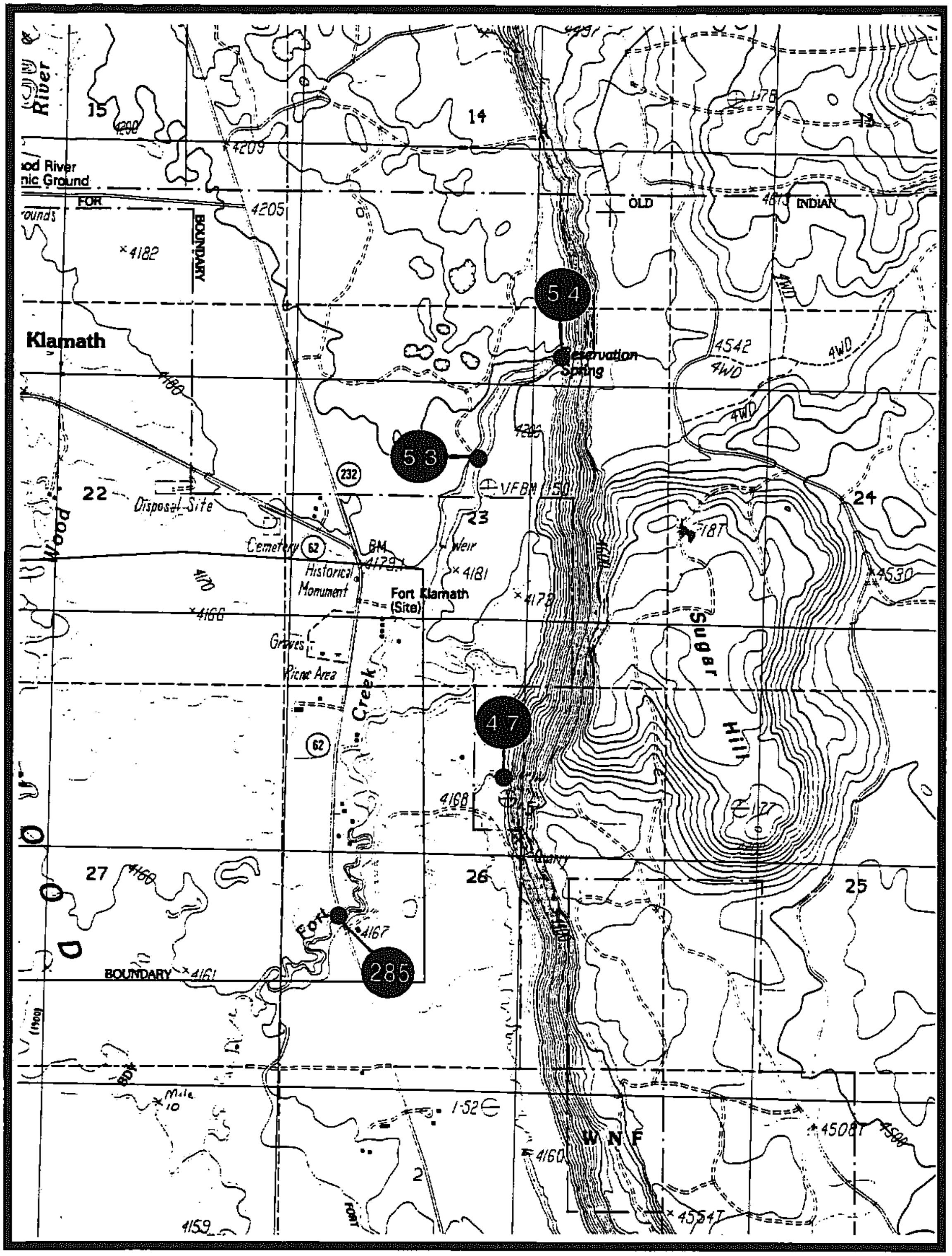


FORT KLAMATH QUADRANGLE, KLAMATH CO., OR
SITES 1, 4, 55

55 = ⓘ
4 = Wood River .001

B39

1 = Wood river .005
crooked creek .007
Mares egg .002

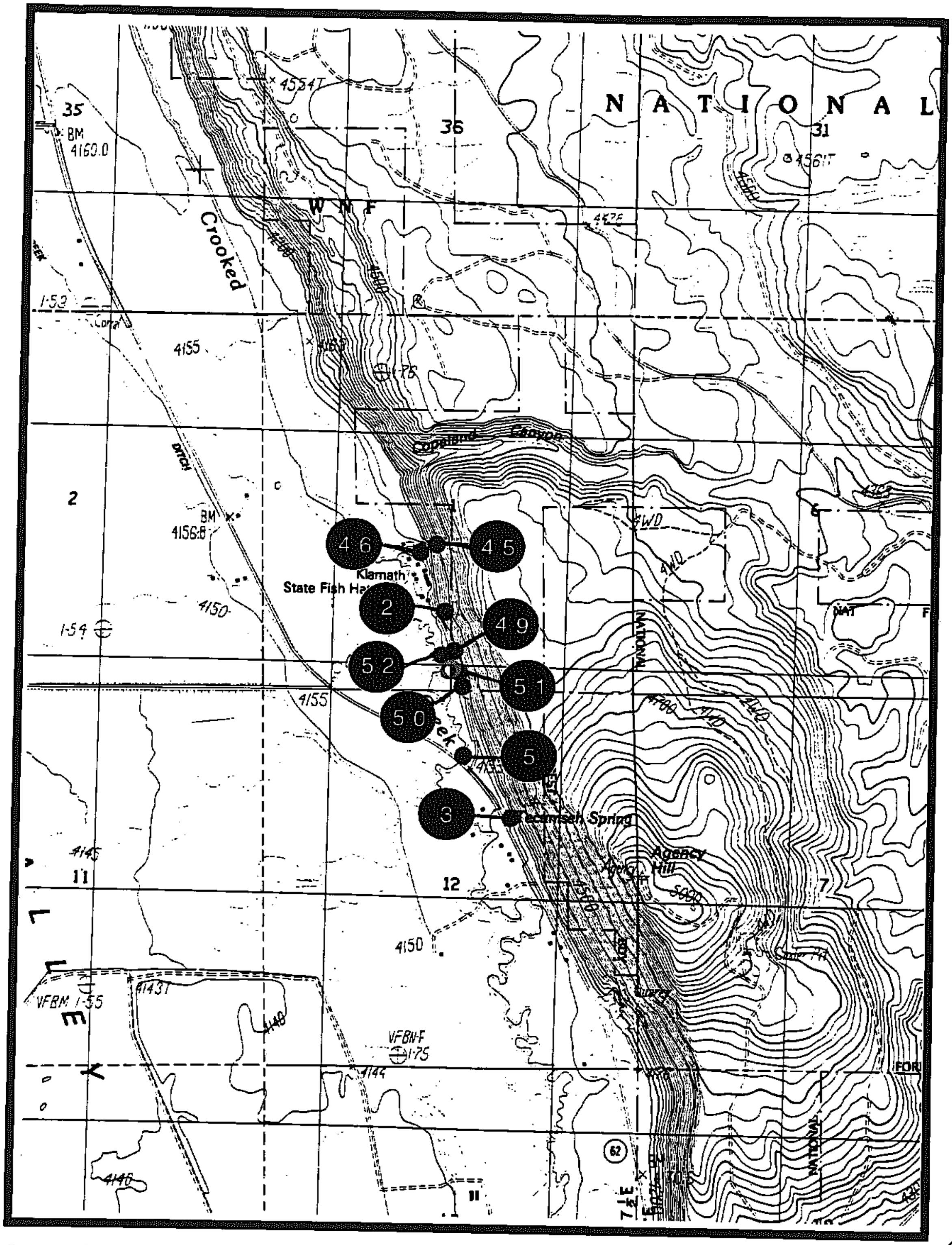


FORT KLAMATH QUADRANGLE, KLAMATH CO., OR
SITES 47, 53, 54, 285

53 = ∅
47 = Wood River .006
crooked creek .008
285 = ∅

54 = wood river .009
crooked crk .014
vort. eff. diag. .003

B40



FORT KLAMATH QUADRANGLE, KLAMATH CO., OR
SITES 2, 3, 5, 45, 46, 49, 50, 51, 52

? 50/51 = wood river .002
? 49/52 crked crk .004
mares .001
var. eff. diag. .001
split out? create new?

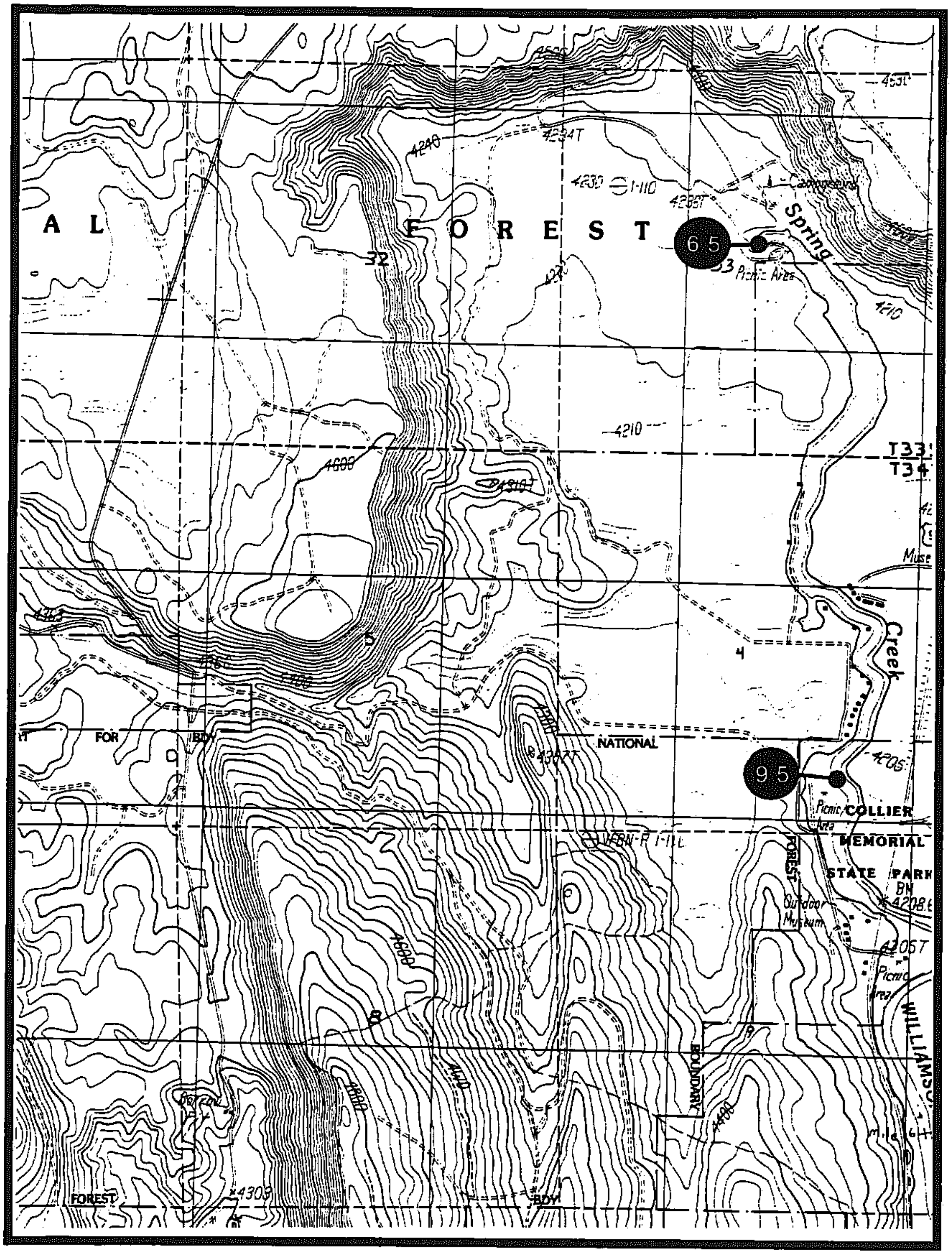
3 = wood riv .007
crked crk .009
lanx Kla .004

B41

5 = crked crk .010
Klamath (Lygo) .002

2 = wood river .003
crked crk .005

45/46 = wood riv .004
crked crk .006



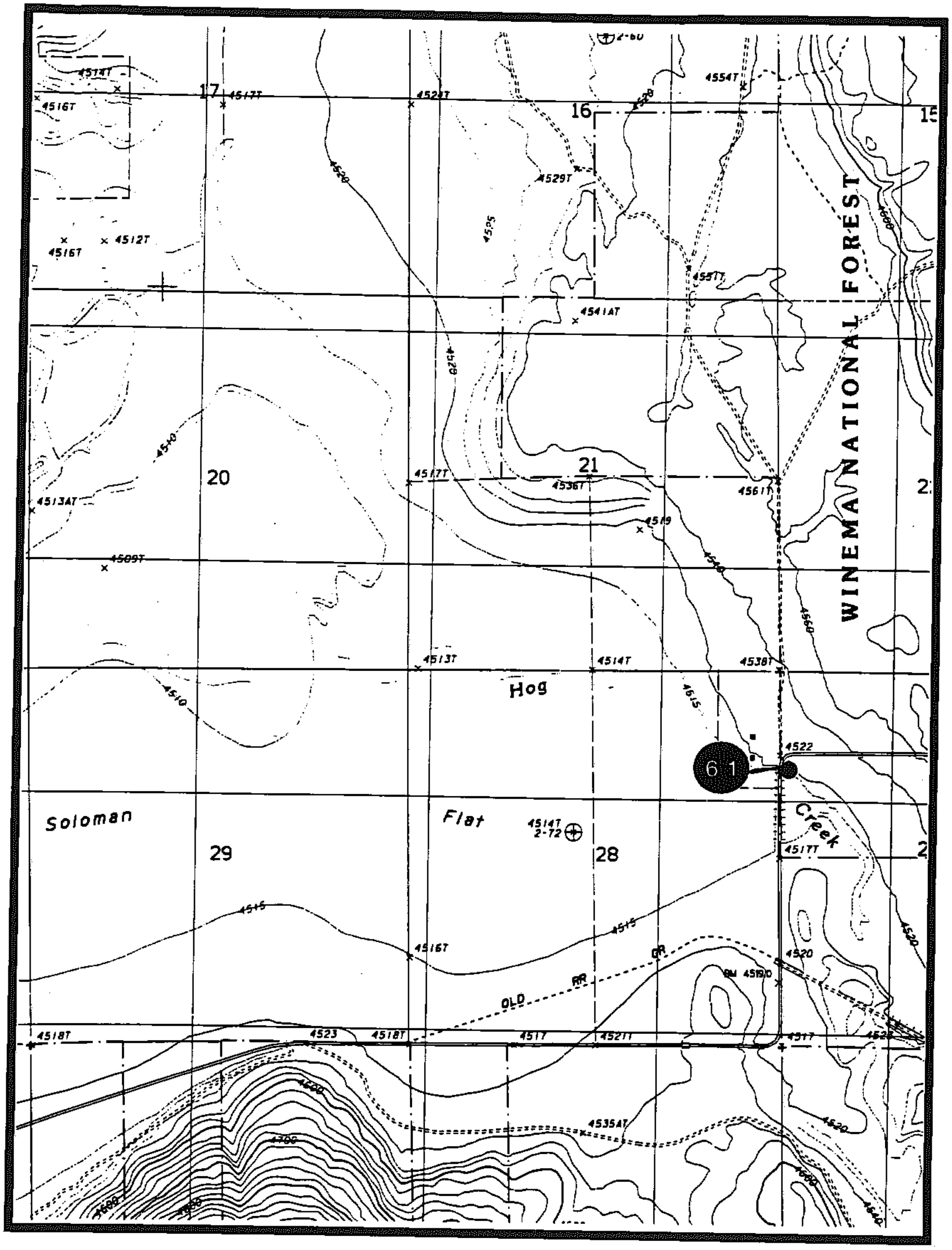
FORT KLAMATH QUADRANGLE, KLAMATH CO., OR
SITES 65, 95

65 = Wood riv. .010
crk crk .015

B42

95 = Wood riv .011
crk crk .016
Lanx alta .003
Vor eff. diag .004
Gon. ang. .002
Marg. fal. .003

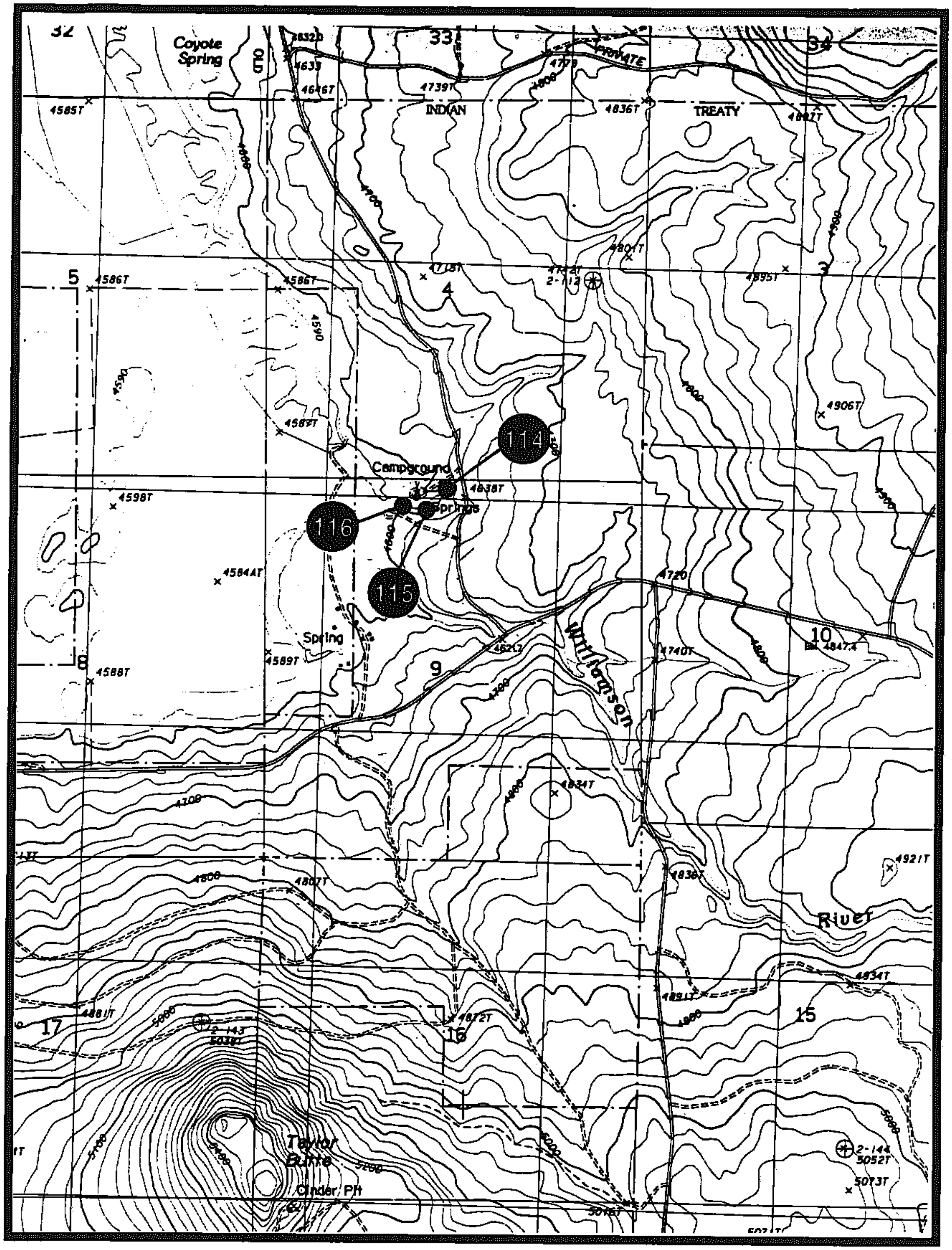
42 121 77 ✓



FUEGO QUADRANGLE, KLAMATH CO., OR
SITE 61 = ∅

B43

42 121 64



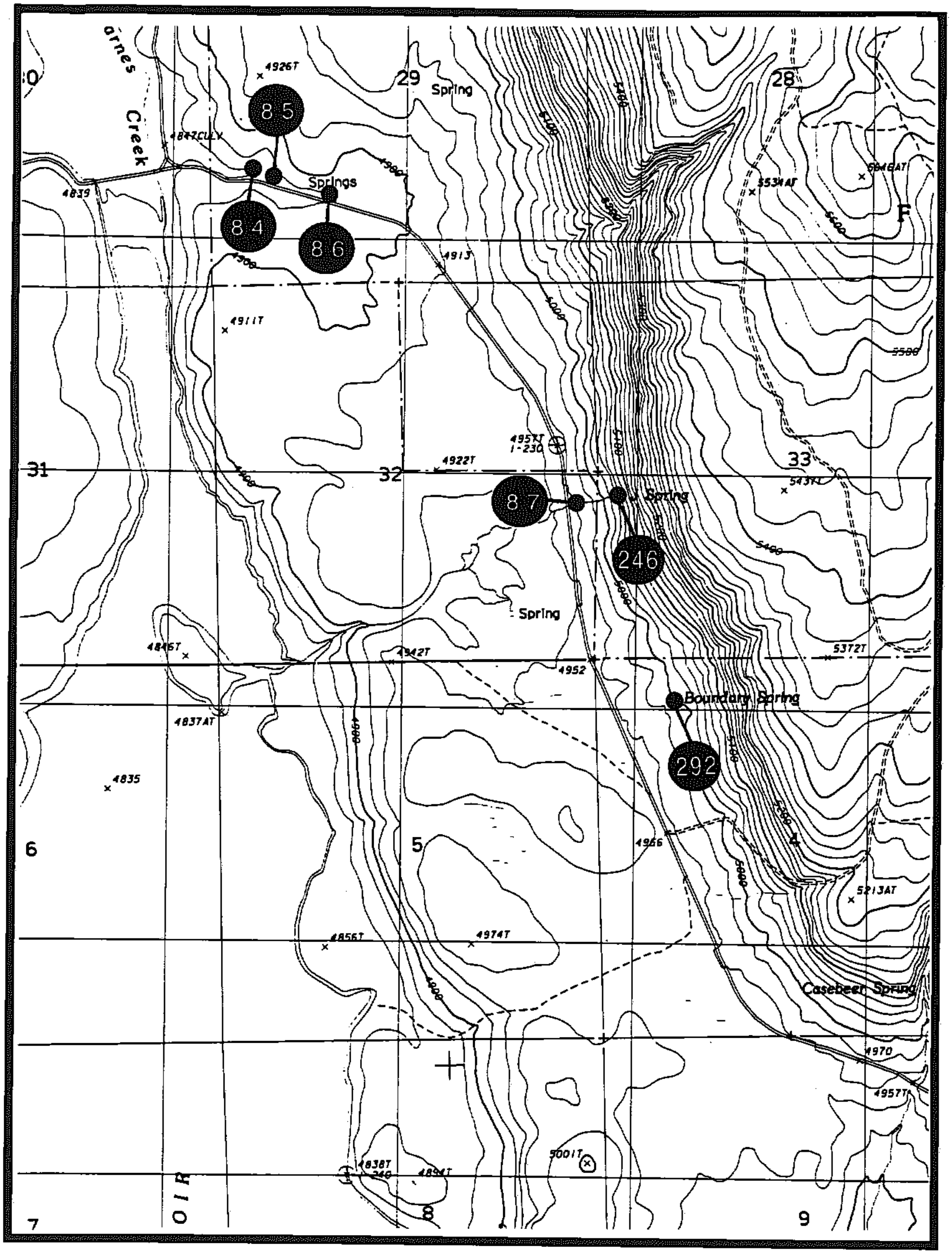
FUEGO MTN. QUADRANGLE, KLAMATH CO., OR
SITES 114, 115, 116

115/114 = ϕ

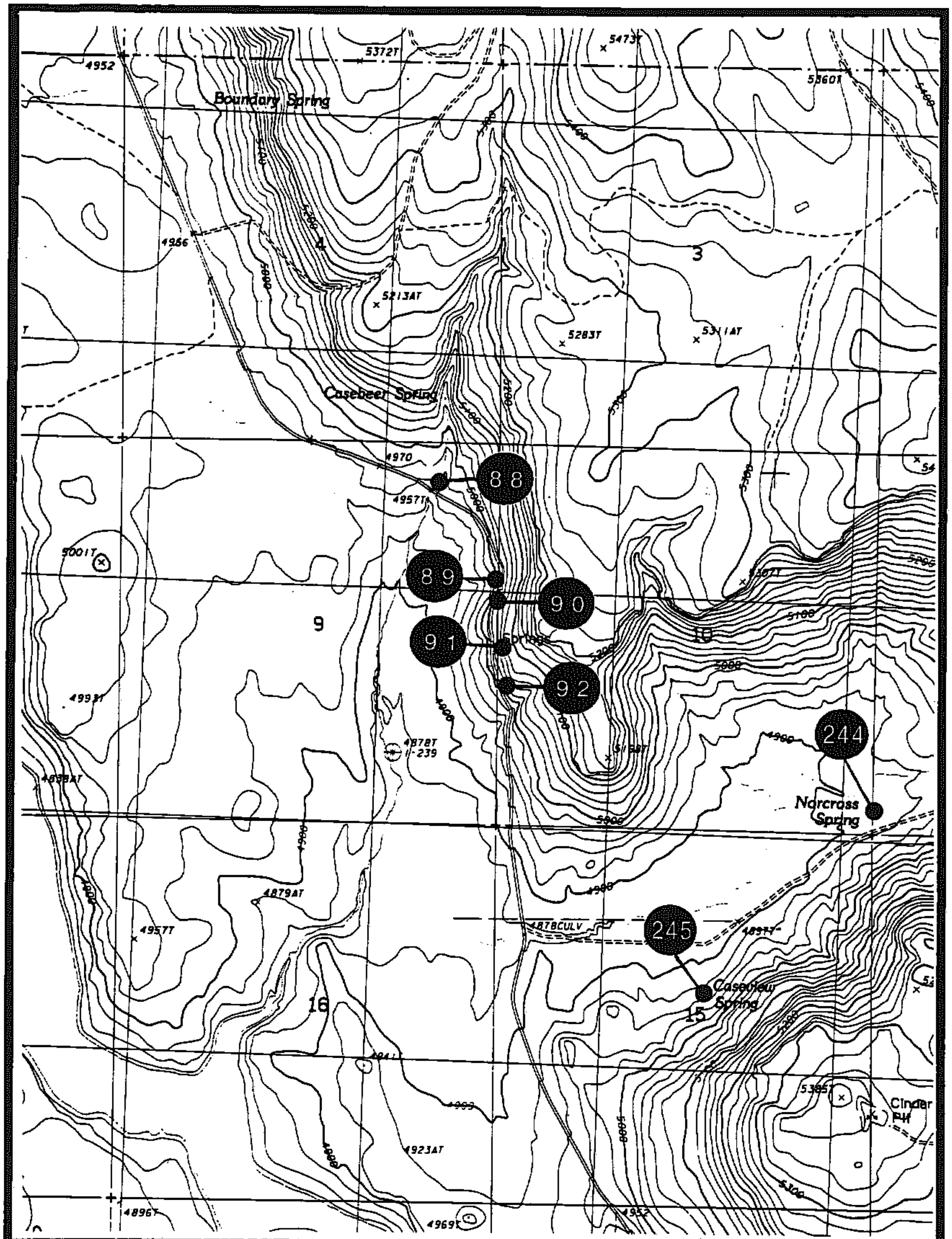
116 = var. eff. dia. .005

B44

42 121 21 √



GERBER RESERVOIR QUADRANGLE, KLAMATH CO., OR
SITES 84, 85, 86, 87, 246, 292 = Ø



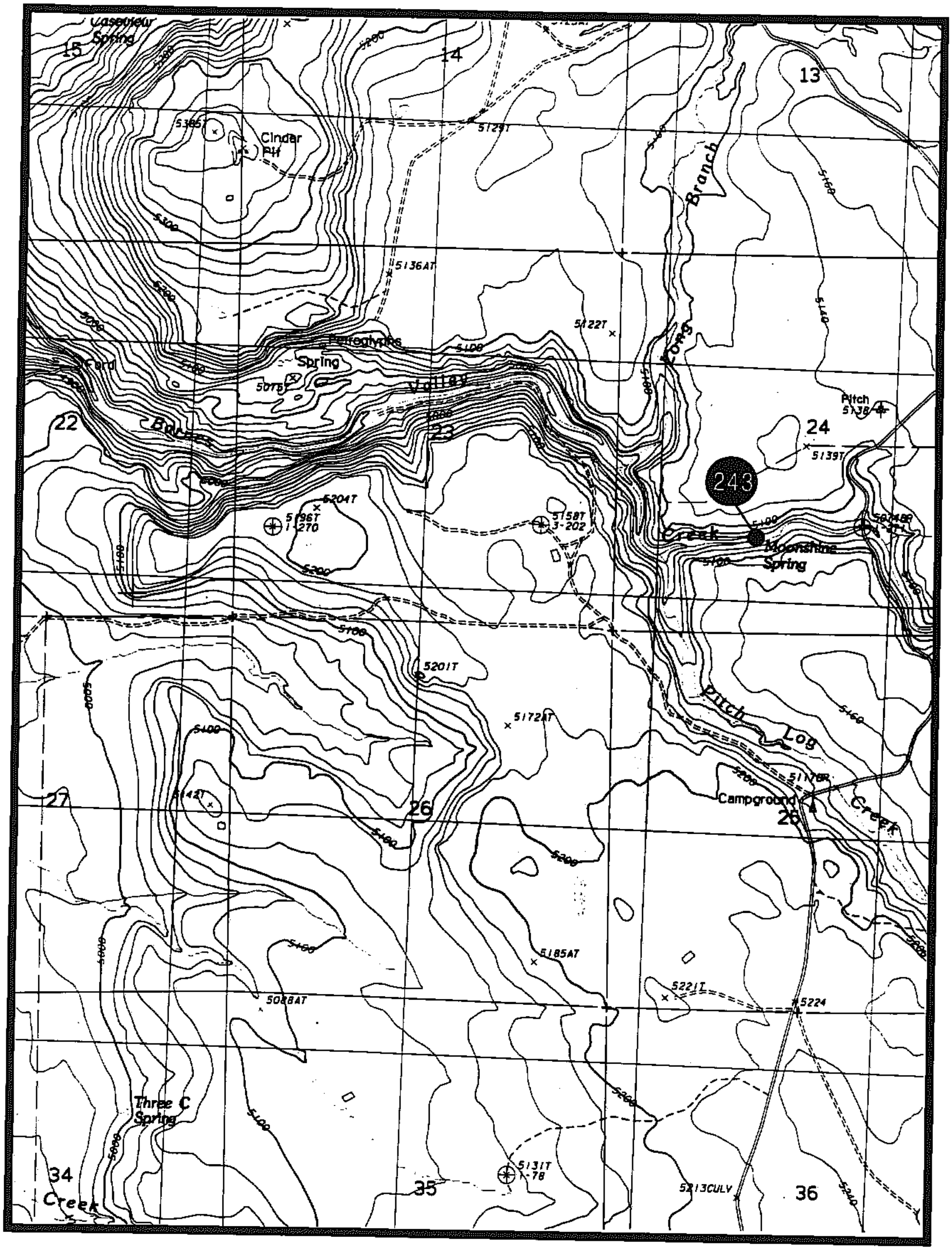
GERBER RESERVOIR QUADRANGLE, KLAMATH CO., OR
SITES 88, 89, 90, 91, 92, 244, 245

88 = Casebeer .001

B46

89, 90, 91, 92, 244, 245 = ∅

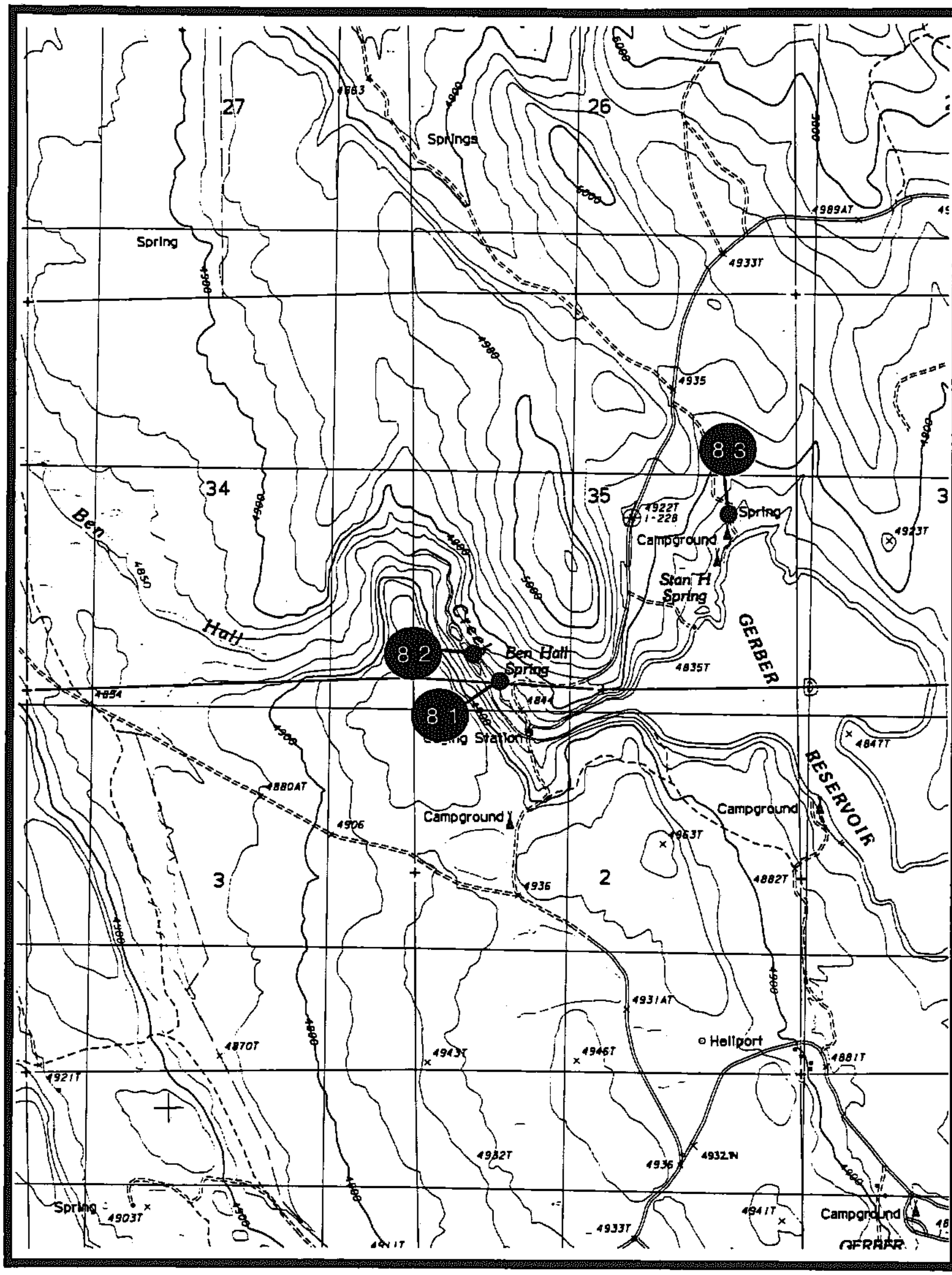
√



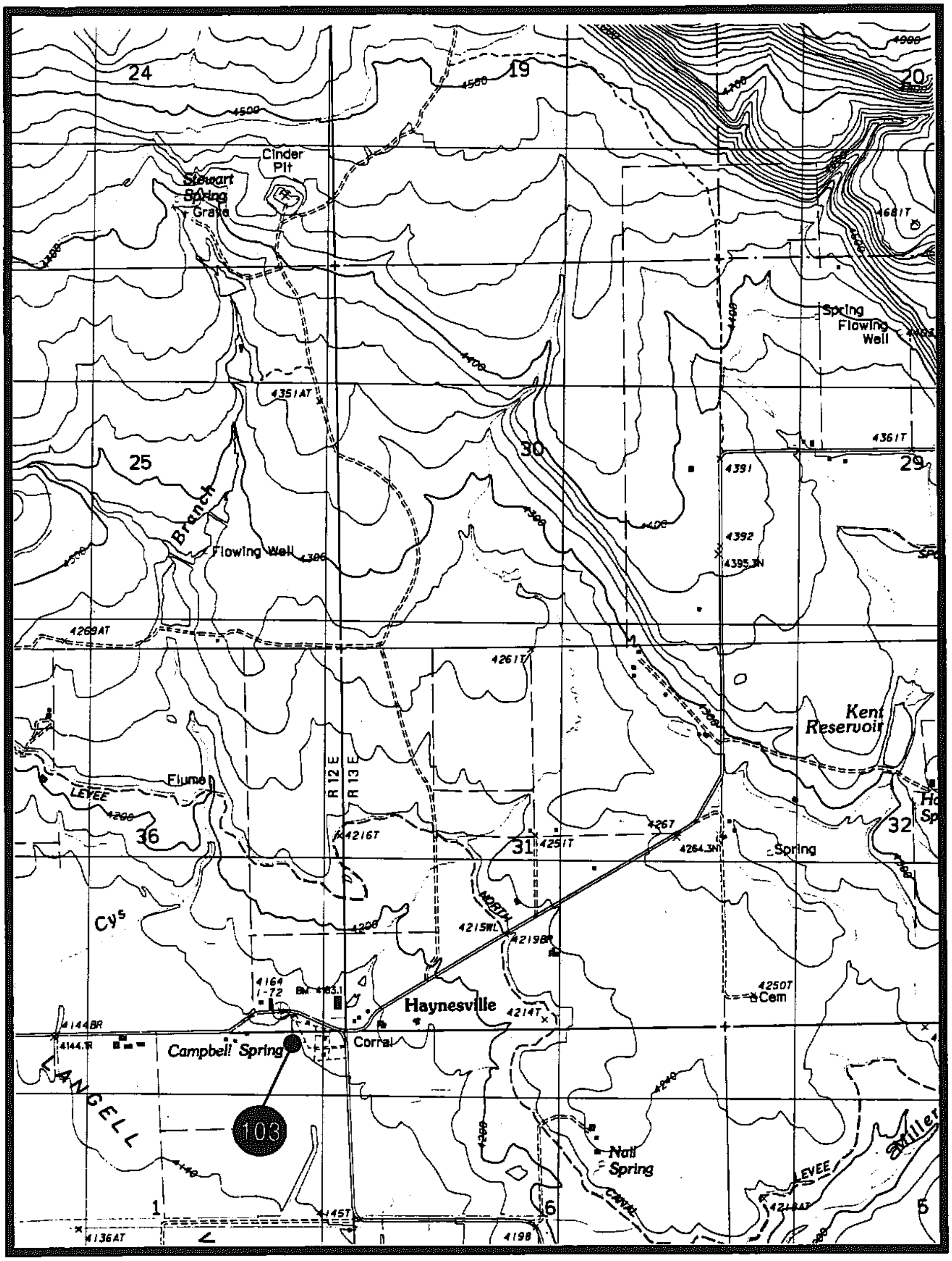
GERBER RESERVOIR QUADRANGLE, KLAMATH CO., OR
SITE 243 = Ø

B47

42 121 22 ✓

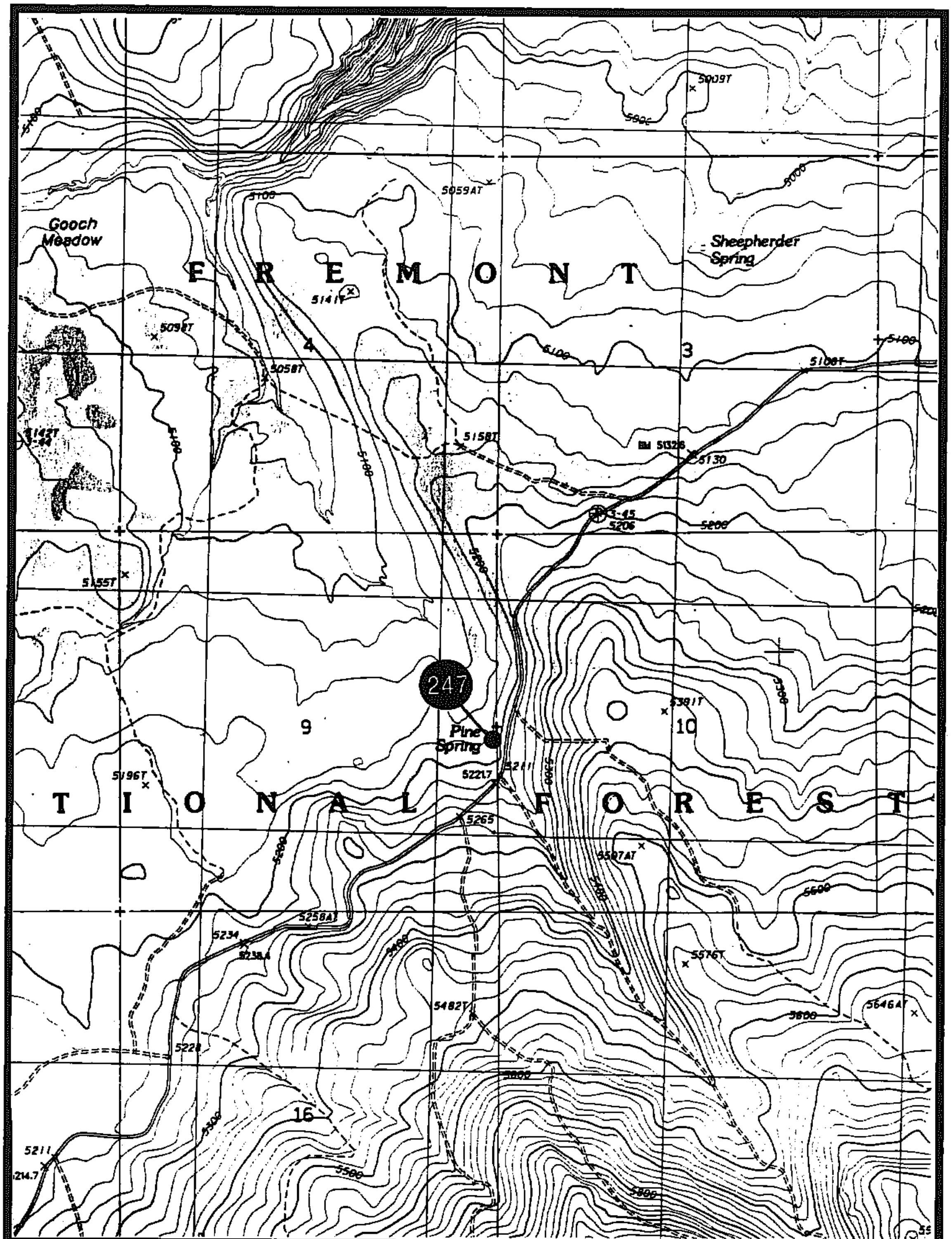


GOODLOW MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITES 81, 82, 83 = ϕ



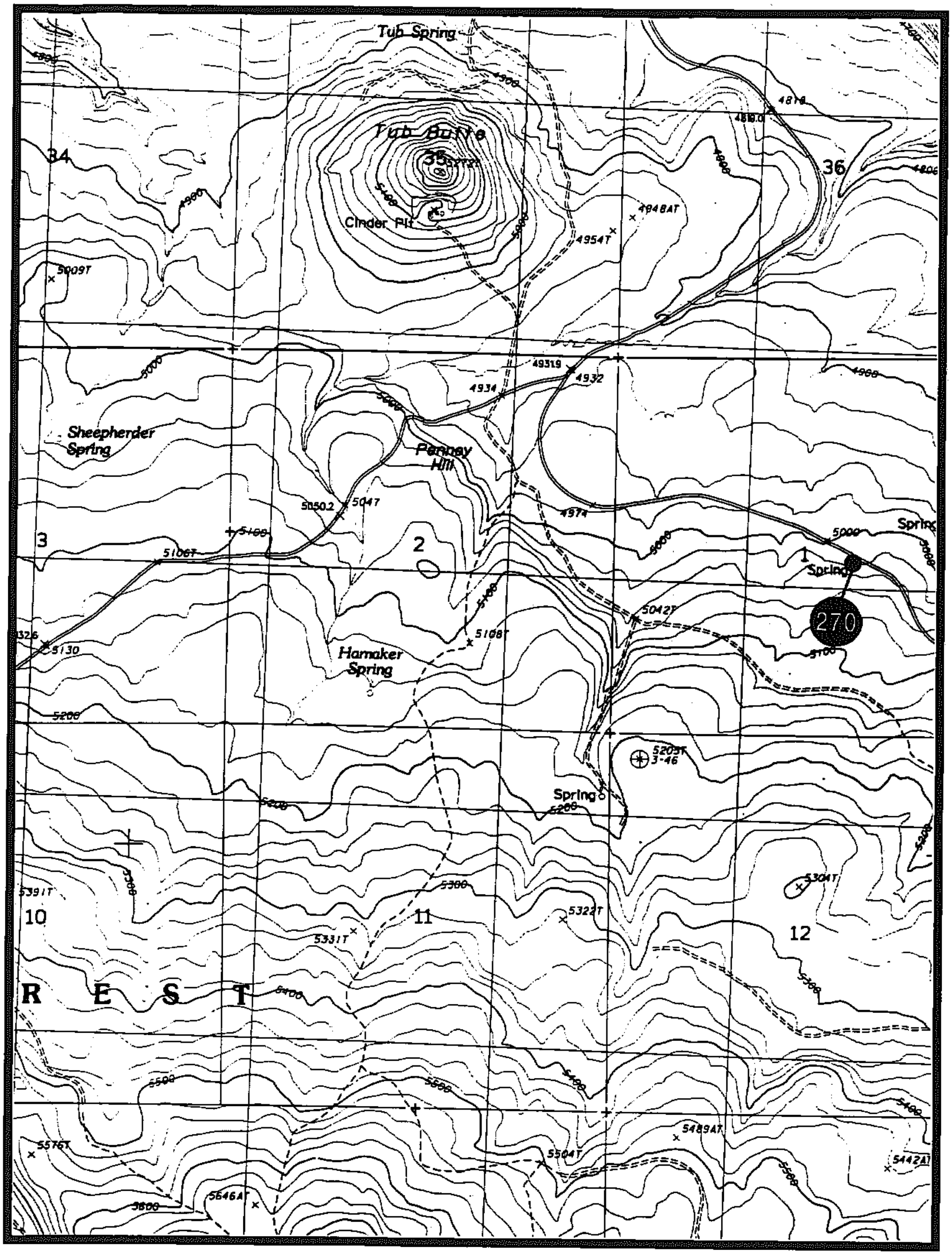
GOODLOW MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITE 103 = φ

4212131 √



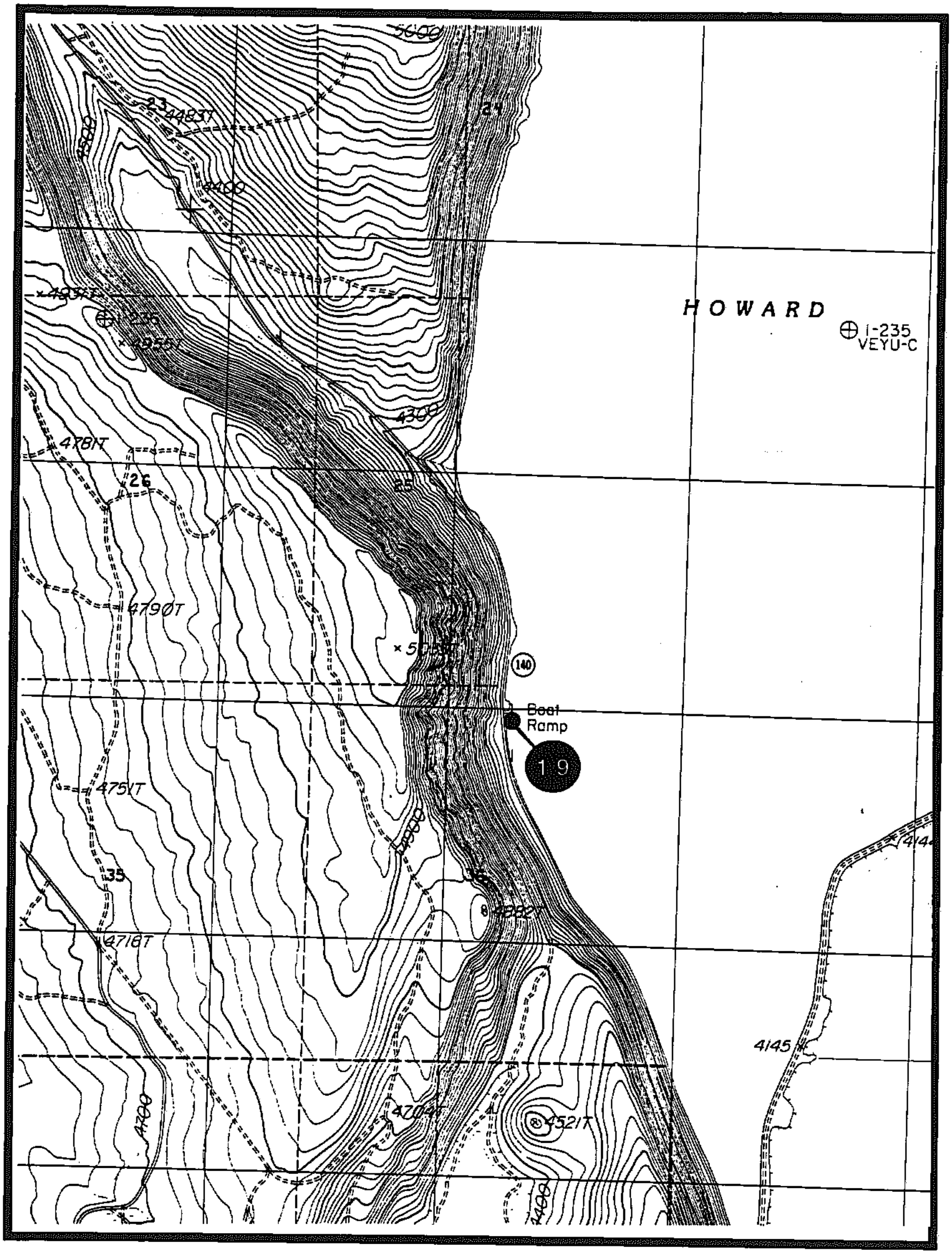
HORSEFLY MOUNTIAN QUADRANGLE, KLAMATH CO., OR
SITE 247 = ∅

B50



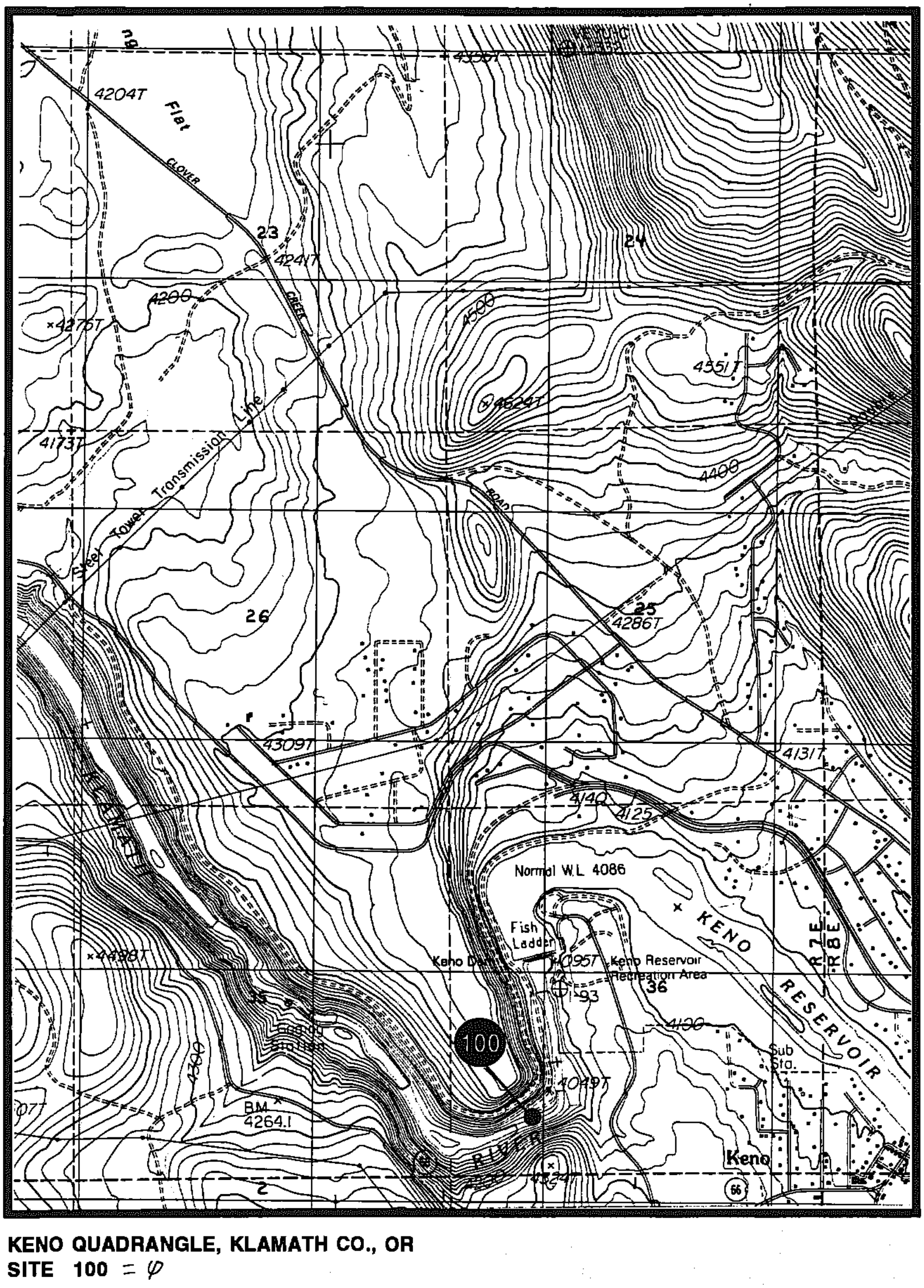
HORSEFLY MOUNTIAN QUADRANGLE, KLAMATH CO., OR
SITE 270 ≃ φ

42 121 38 ✓



HOWARD BAY QUADRANGLE, KLAMATH CO., OR
SITE 19 = ∅

42 12 28

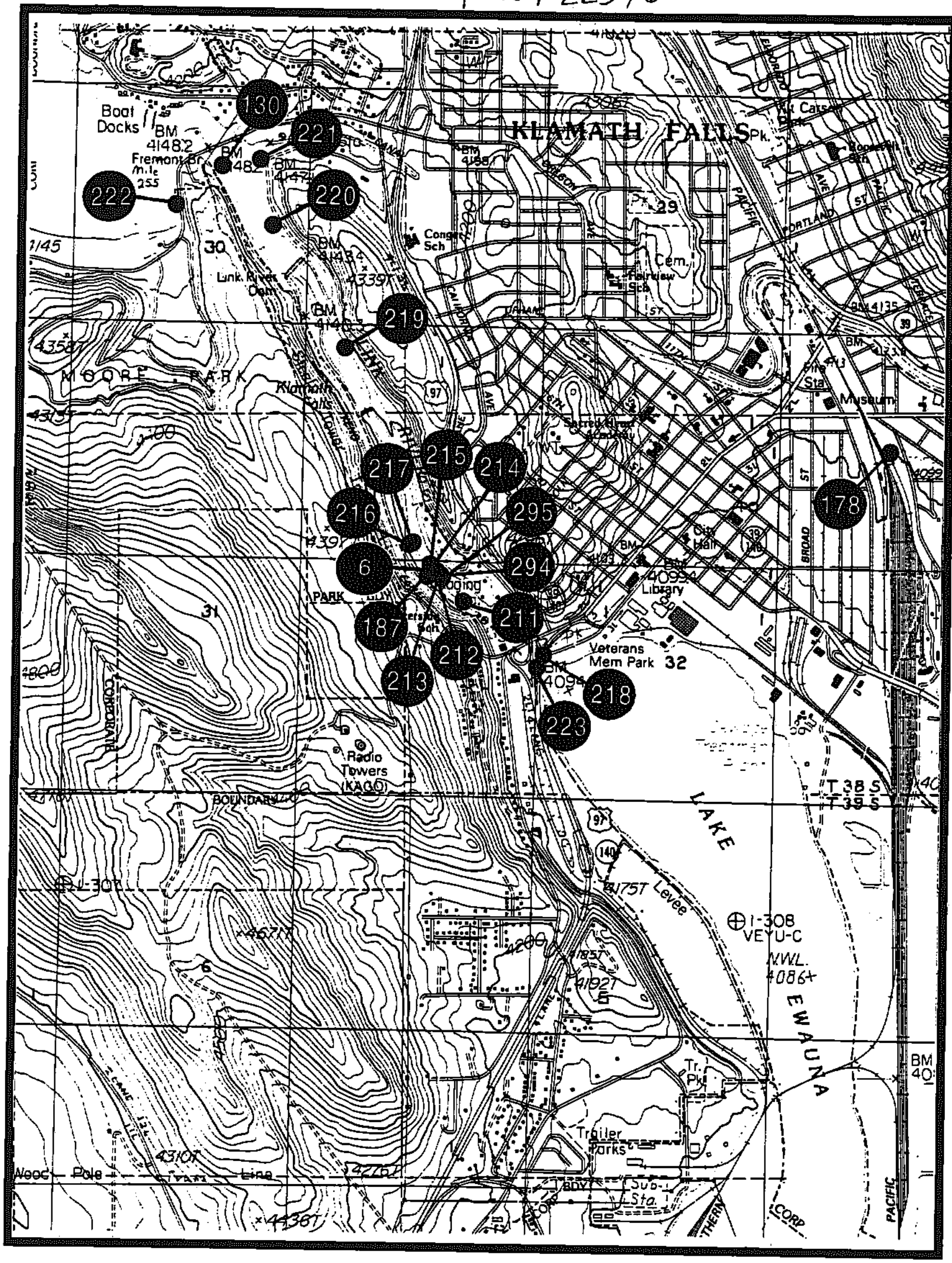


KENO QUADRANGLE, KLAMATH CO., OR
SITE 100 = φ

River = 130, 221, 220, 219 216 217
211, 218, 223, 6

42 12 27 ✓

222 = lake



6 = river

212-215
187 are
springs
(294 + 295)
springs

KLAMATH FALLS QUADRANGLE, KLAMATH CO., OR (see also Figure 3)
SITES 6, 130, 178, 187, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 294, 295

vor. Kla Kla .001
O = Klamath .001
Lyg Archimedis .002
Klam. Lake .002
dalls ram .001

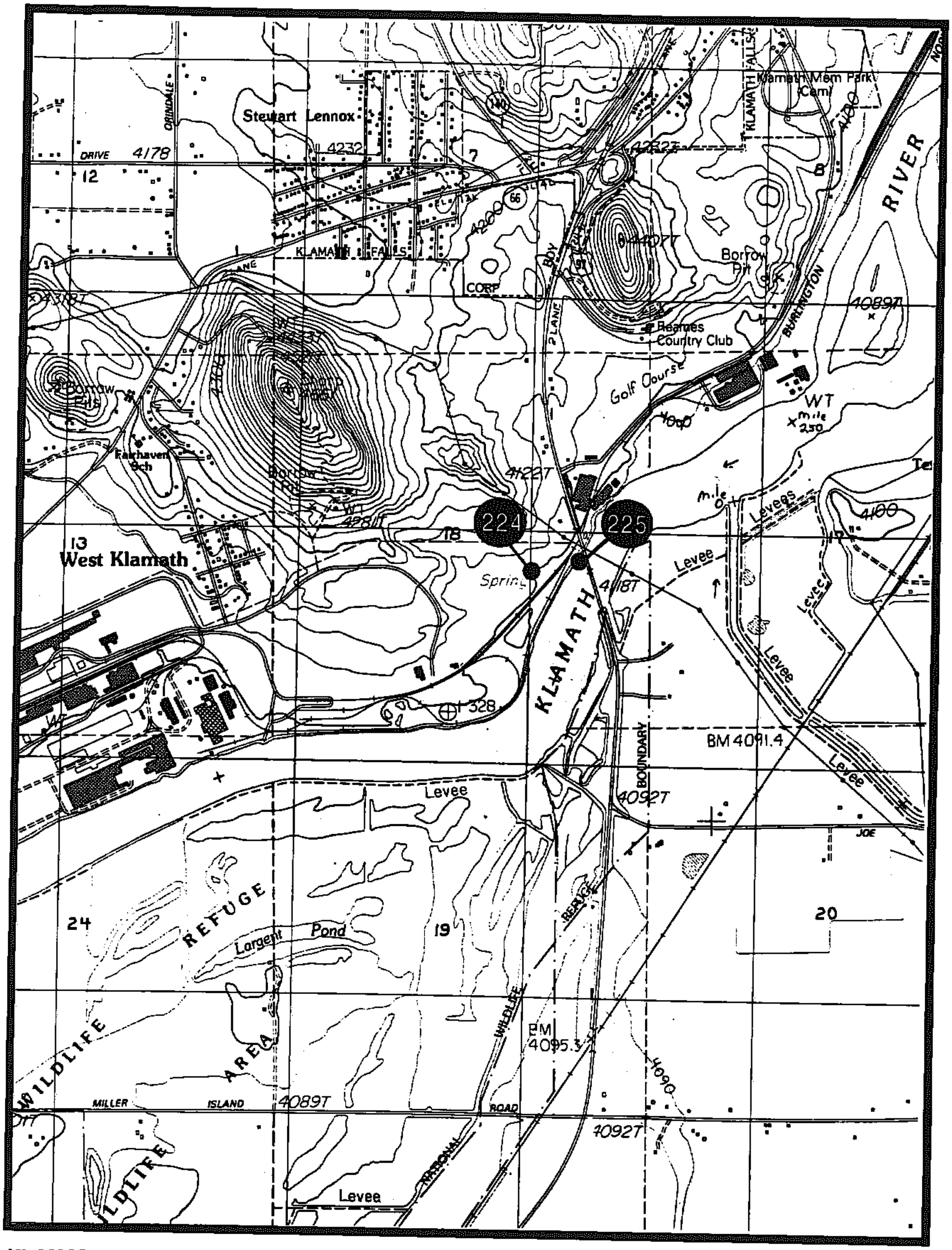
combine?

B54

130 = vor Kla Kla .005
Pis mont. .002
Pd Klamath .011
dalls .003

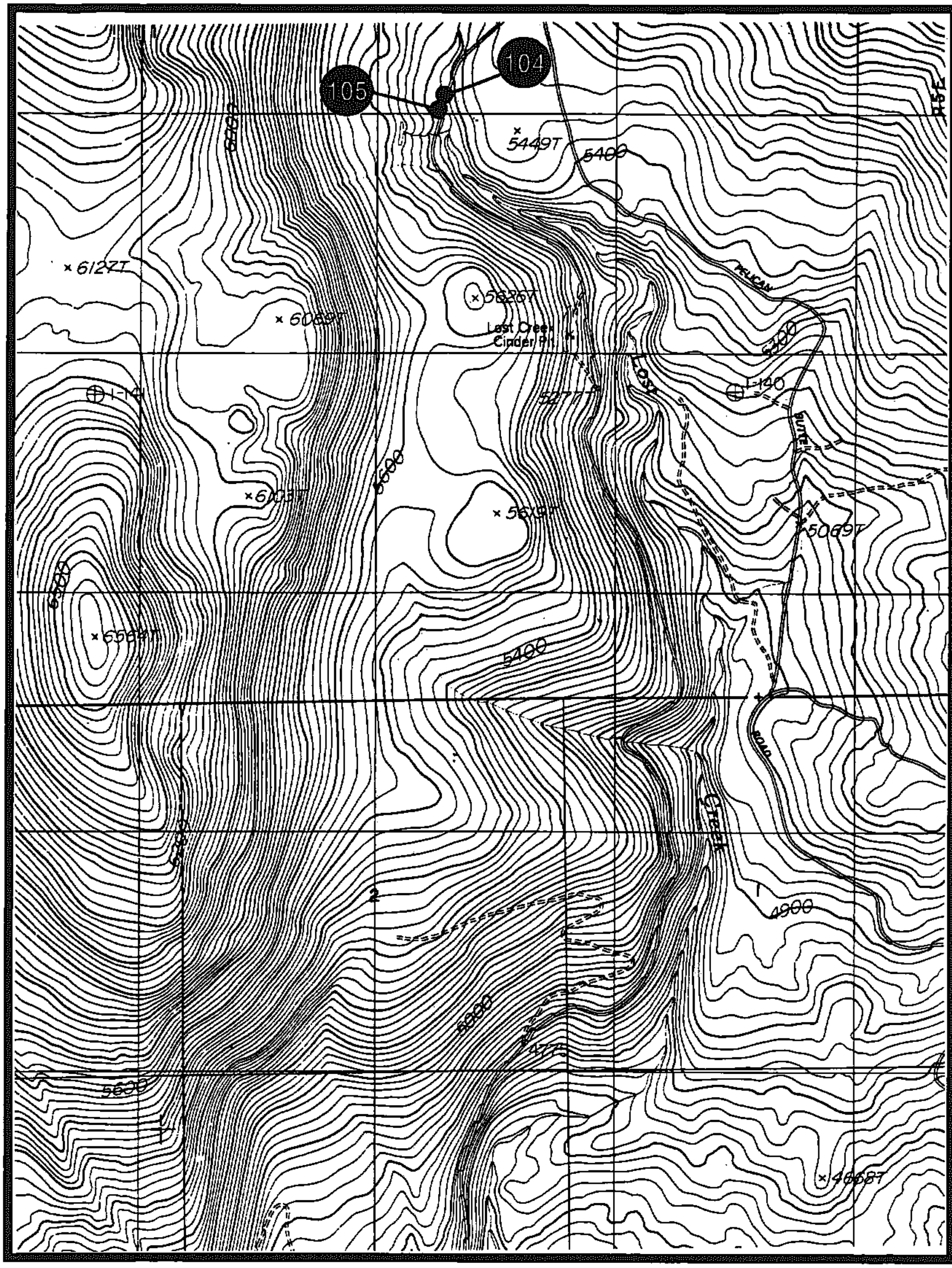
178, 220-222
219
216, 217
211 218
223 = ∅

√



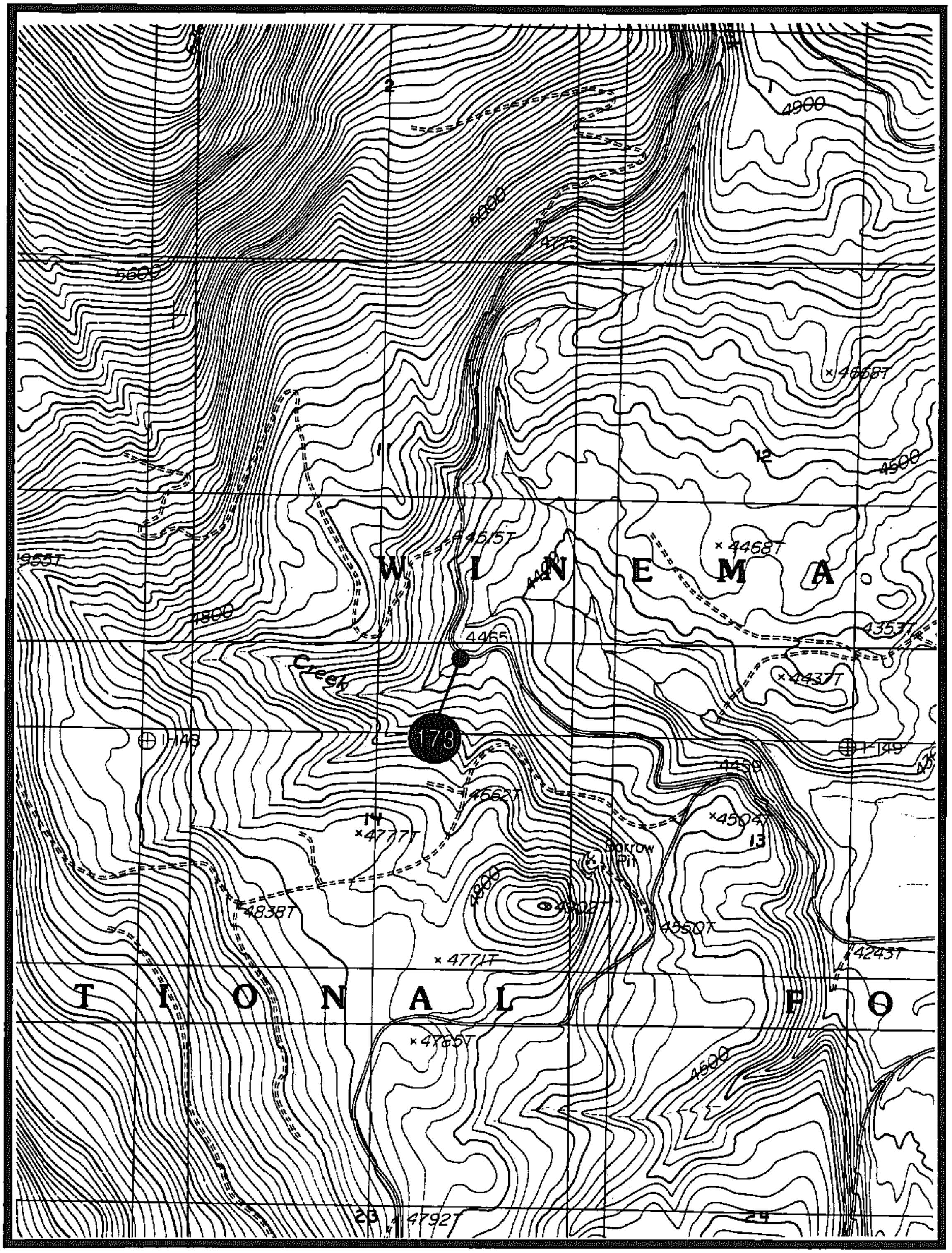
KLAMATH FALLS QUADRANGLE, KLAMATH CO., OR
SITES 224, 225 = Ø

42 122 42 √

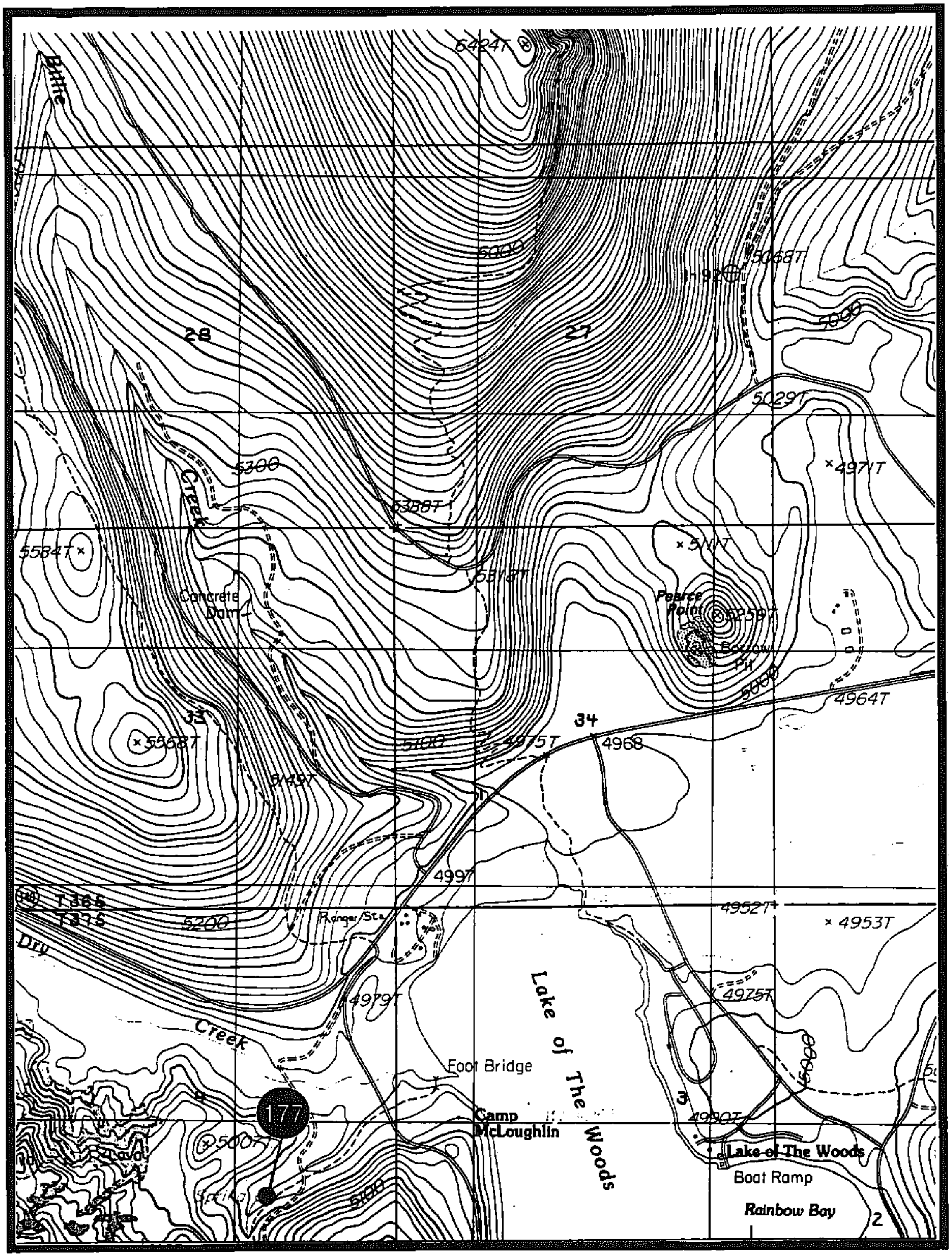


LAKE OF THE WOODS NORTH QUADRANGLE, KLAMATH CO., OR
SITES 104, 105 = ∅

J

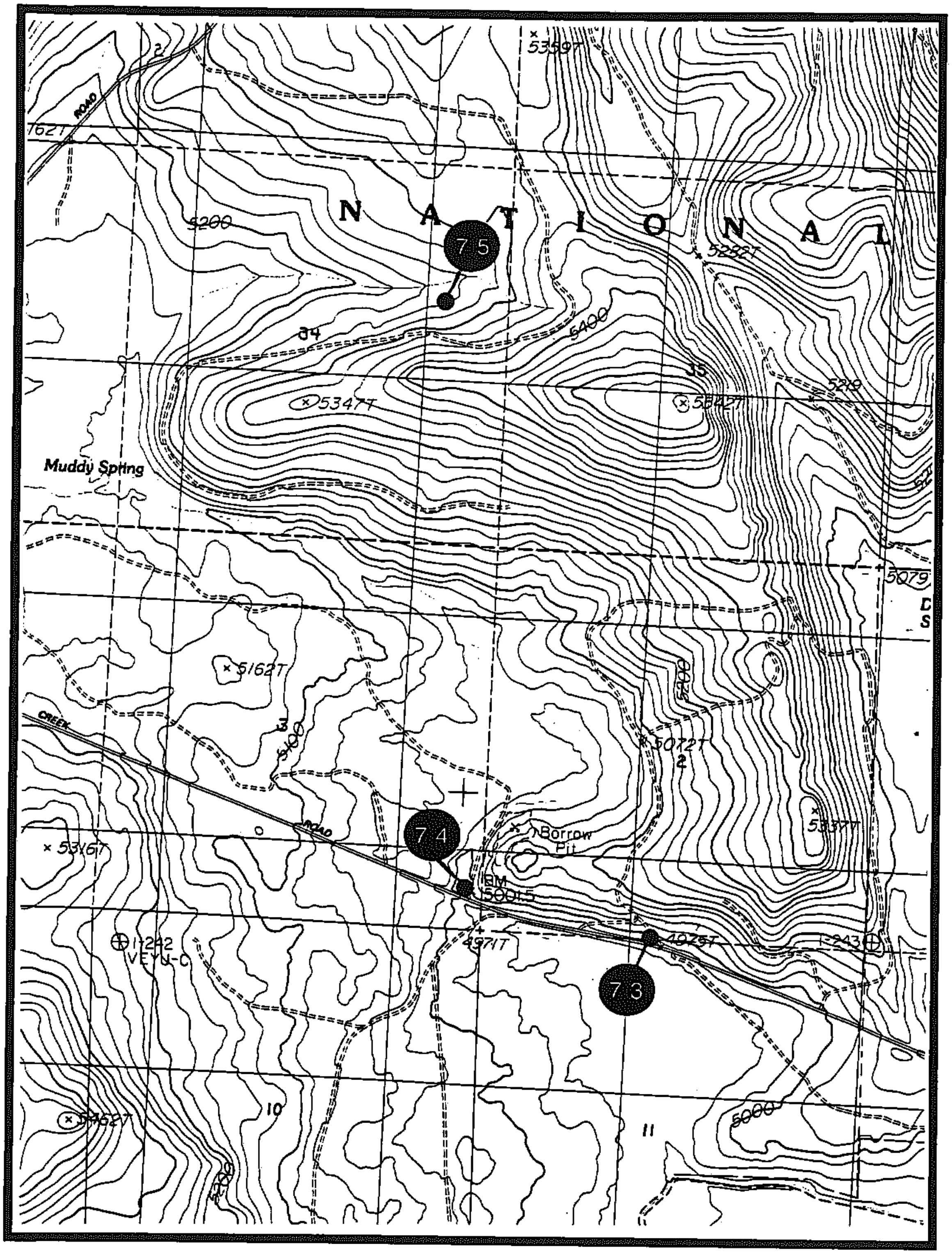


LAKE OF THE WOODS NORTH QUADRANGLE, KLAMATH CO., OR
SITE 173 = Ø



LAKE OF THE WOODS NORTH QUADRANGLE, KLAMATH CO., OR
SITE 177 = ∅

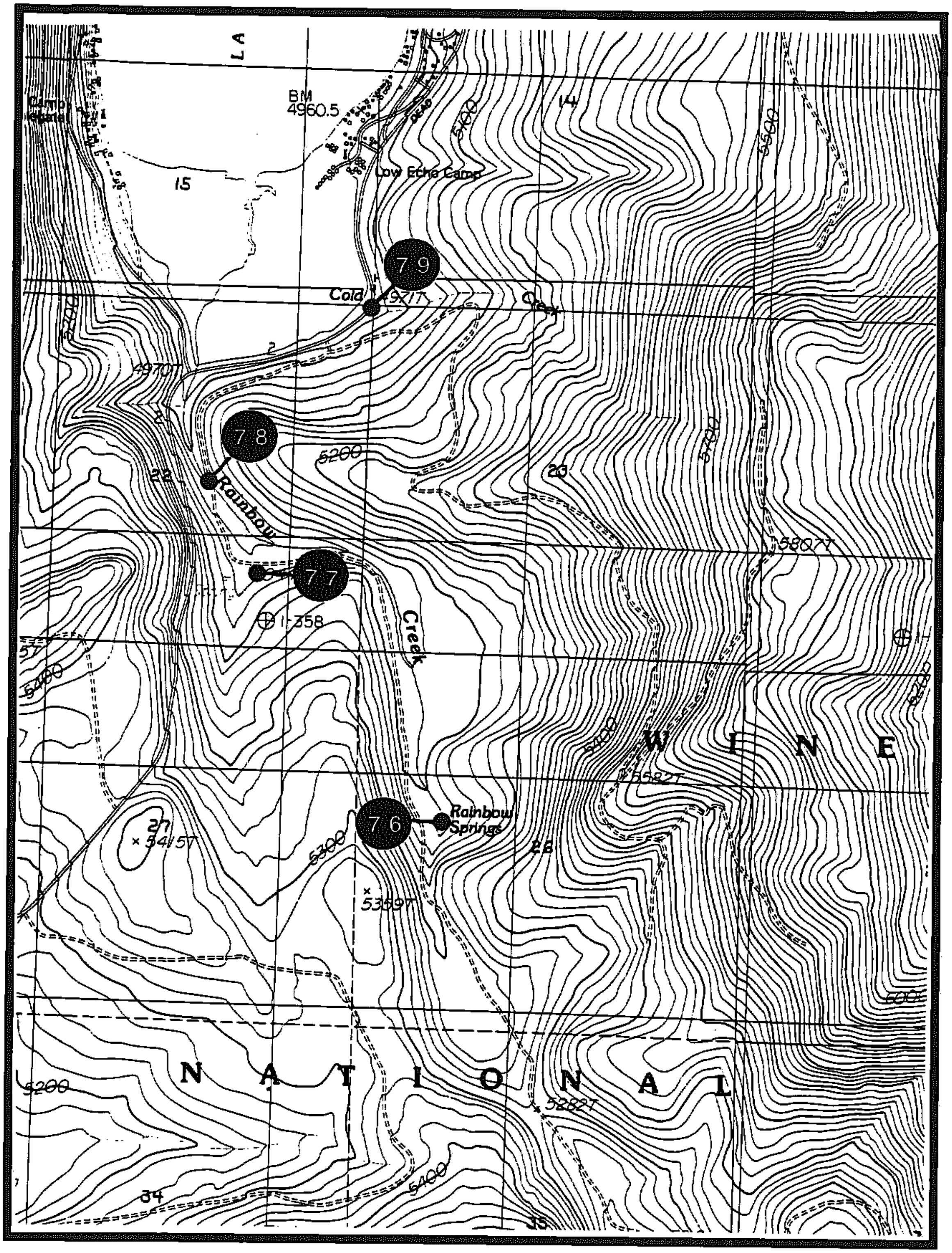
42122 32



LAKE OF THE WOODS SOUTH QUADRANGLE, KLAMATH CO., OR
SITES 73, 74, 75

74 = Lak of Woods .006

73, 75 = Ø

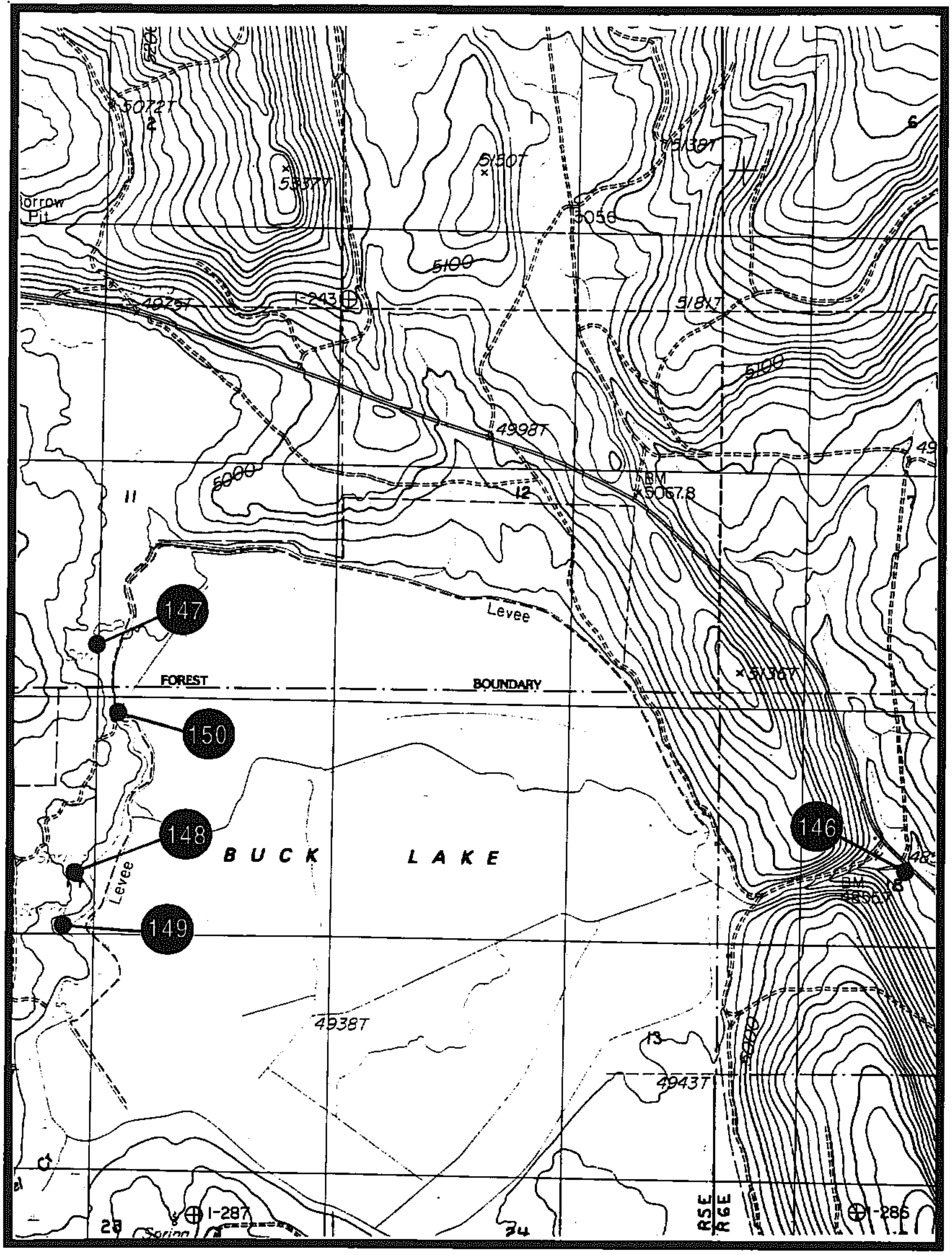


LAKE OF THE WOODS SOUTH QUADRANGLE, KLAMATH CO., OR
SITES 76, 77, 78, 79

78 = φ
79 = Lake o woods .005
76 = φ
77 = " " .004

B60

J



LAKE OF THE WOODS SOUTH QUADRANGLE, KLAMATH CO., OR
SITES 146, 147, 148, 149, 150

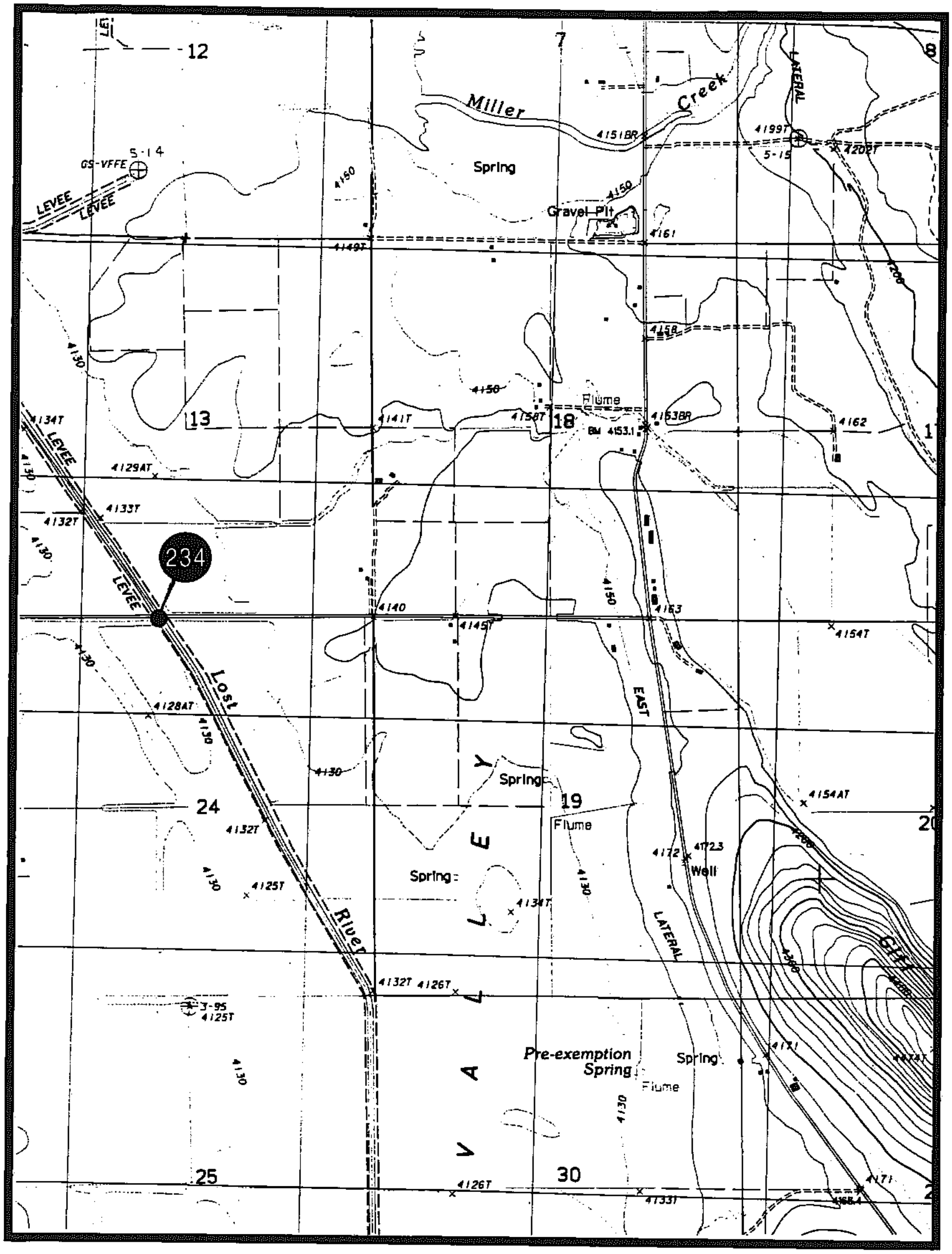
146 = ϕ 147 = ϕ 148 = ϕ

150 = Lake o Woods .011

149 = Lake o Woods .008

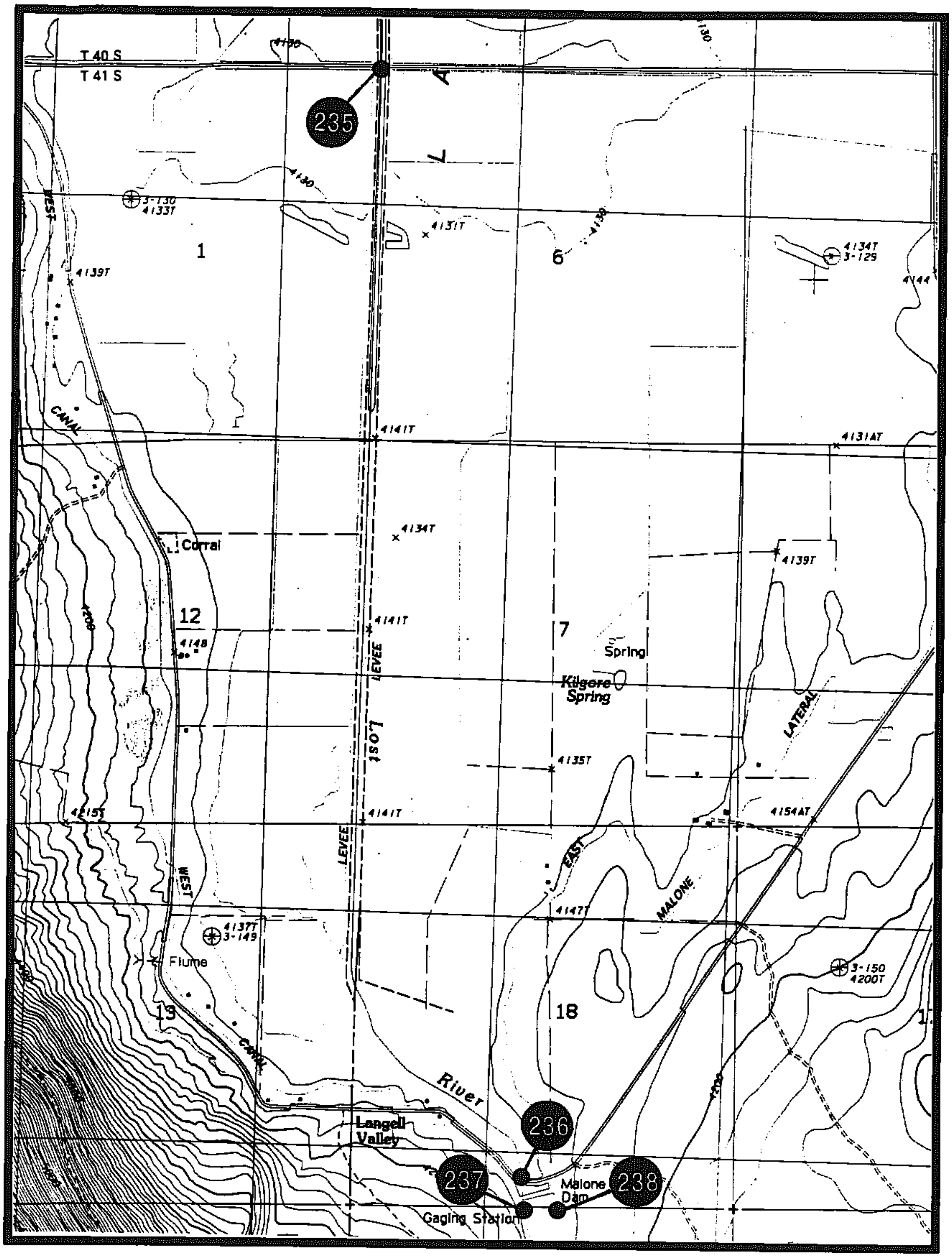
B61

42 121 12 J



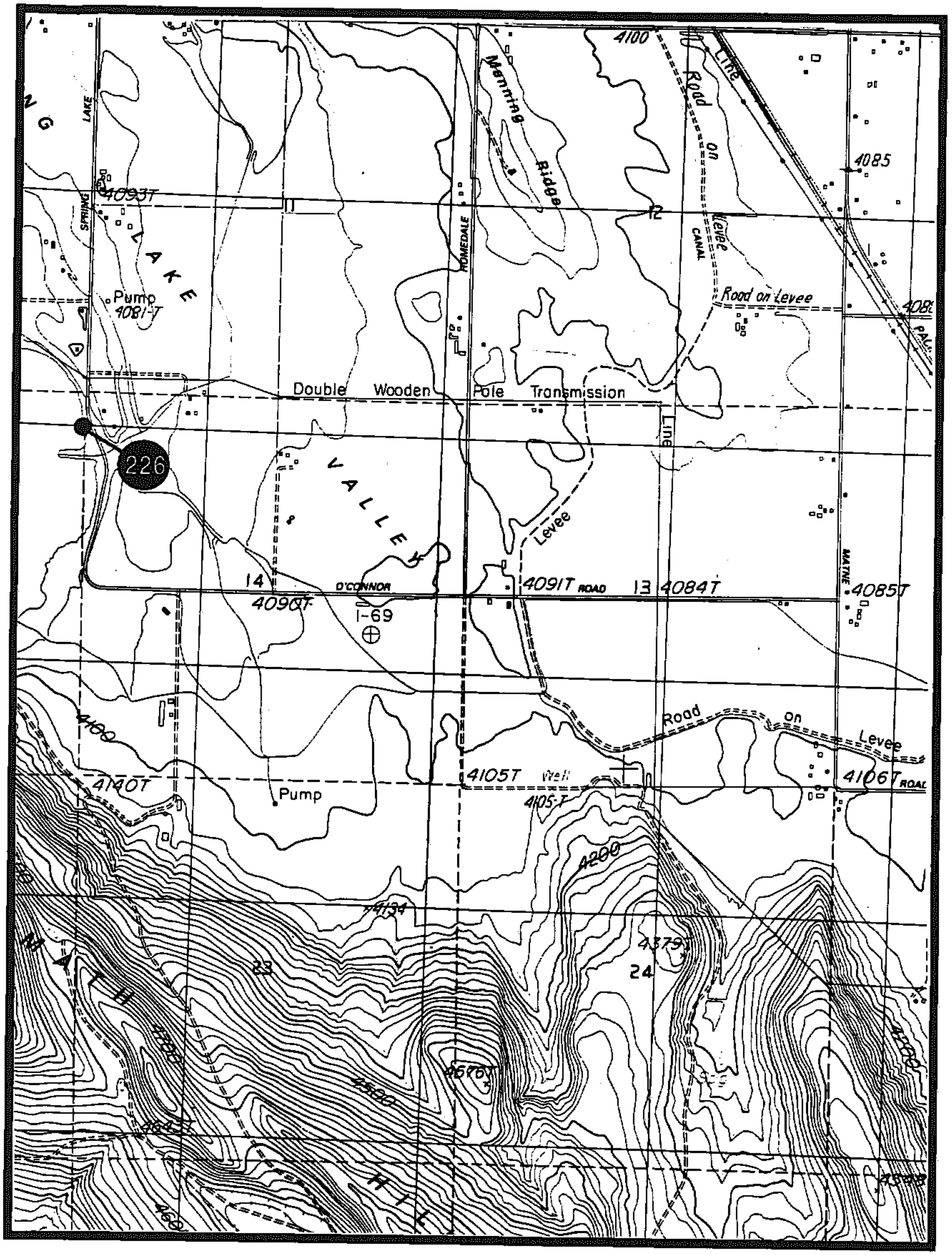
LANGELL VALLEY QUADRANGLE, KLAMATH CO., OR
SITE 234 = φ

✓

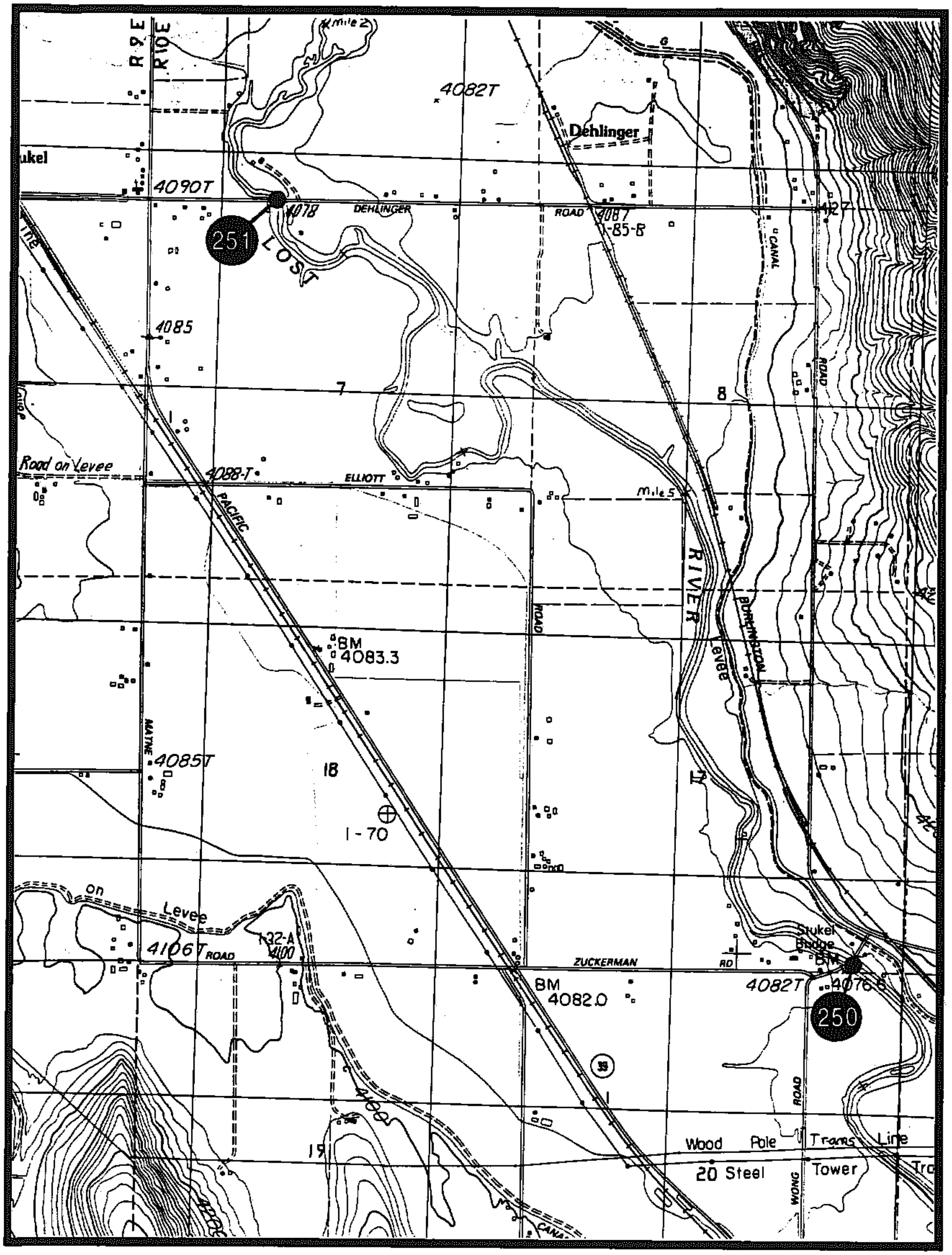


LANGELL VALLEY QUADRANGLE, KLAMATH CO., OR
SITES 235, 236, 237, 238 = Ø

42 121 16 ✓

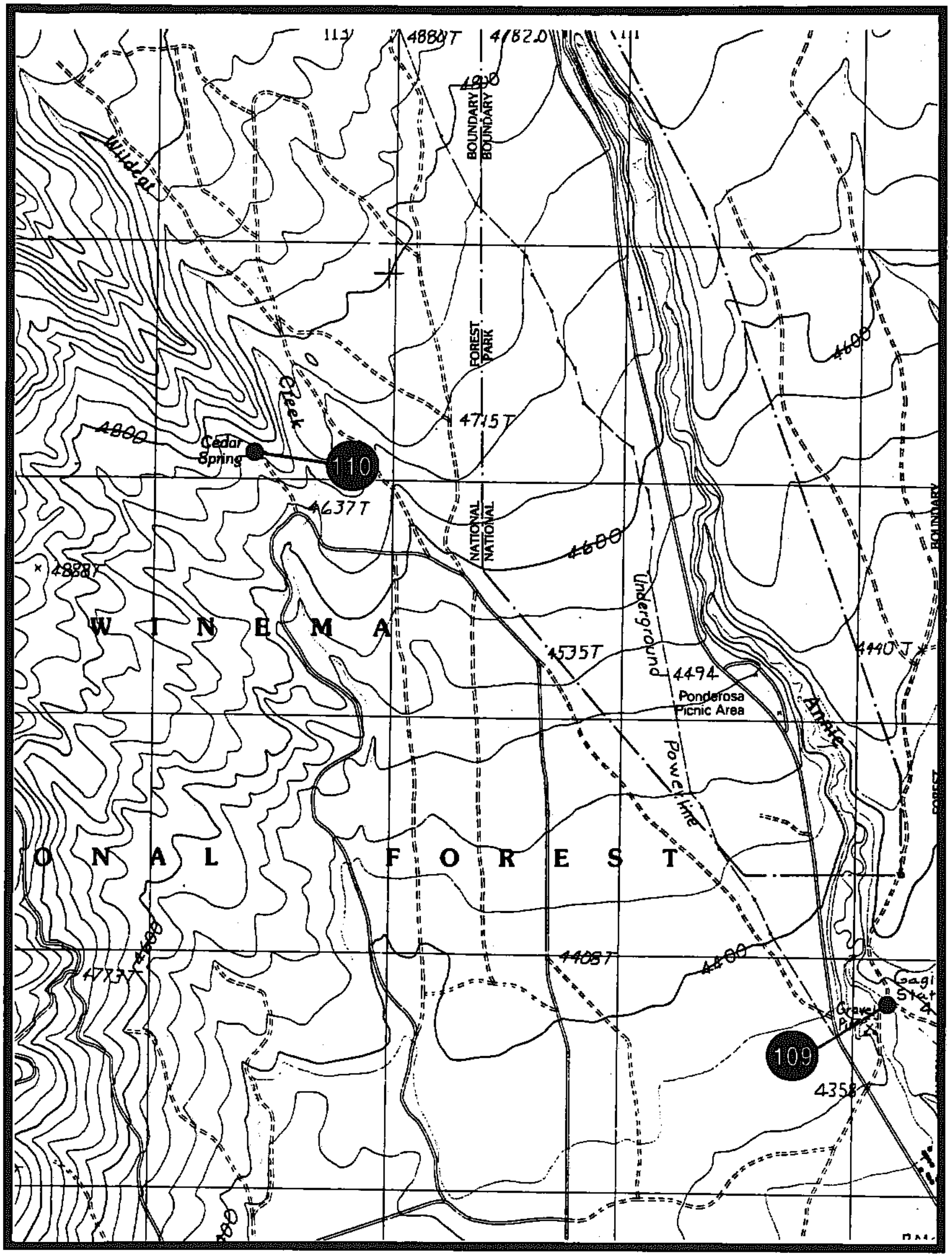


LOST RIVER QUADRANGLE, KLAMATH CO., OR
SITE 226 = ∅



LOST RIVER QUADRANGLE, KLAMATH CO., OR
SITES 250, 251 = 0

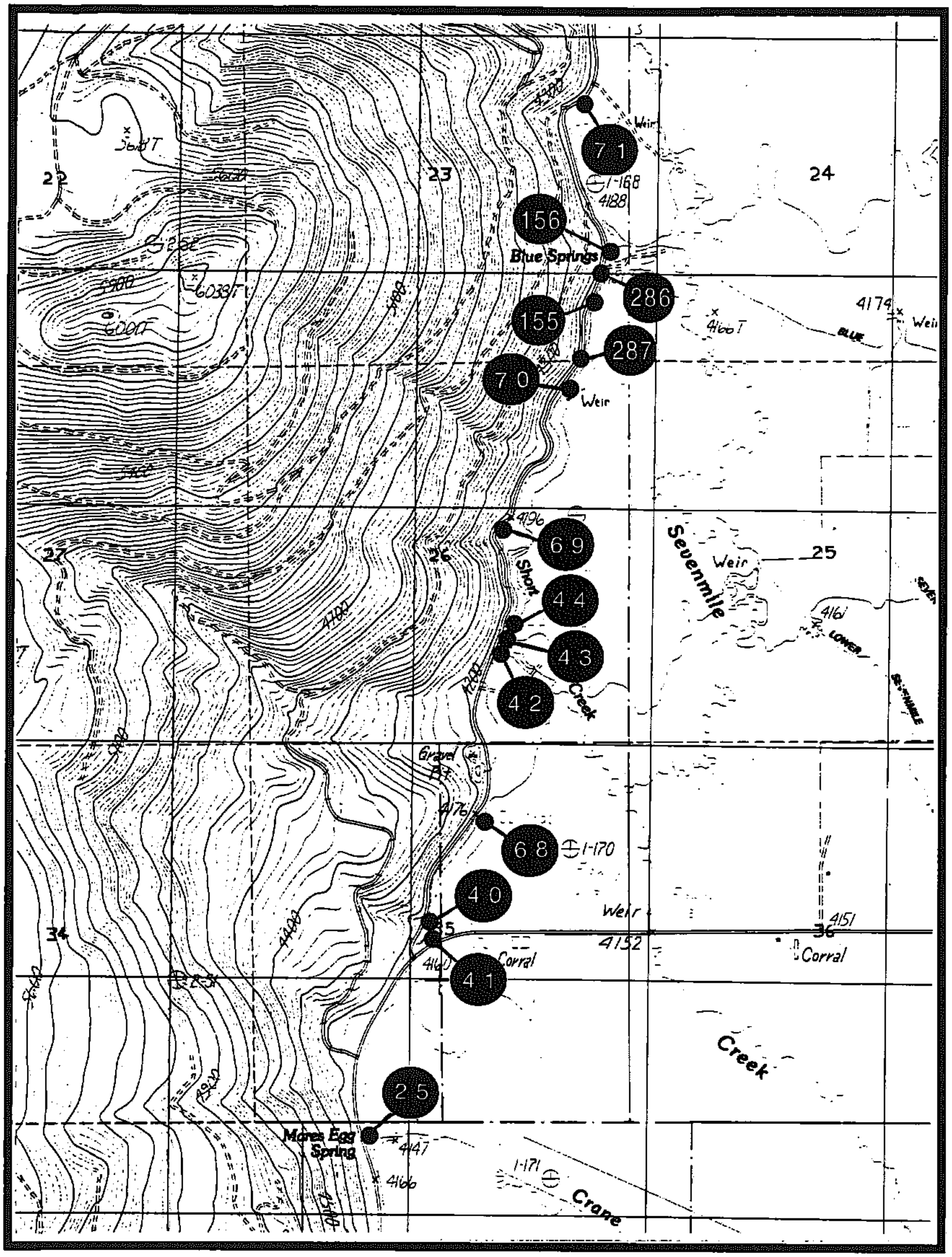
42 122 71



MAKLAKS CRATER QUADRANGLE, KLAMATH CO., OR
SITES 109, 110 = ϕ

B66

42 122 61



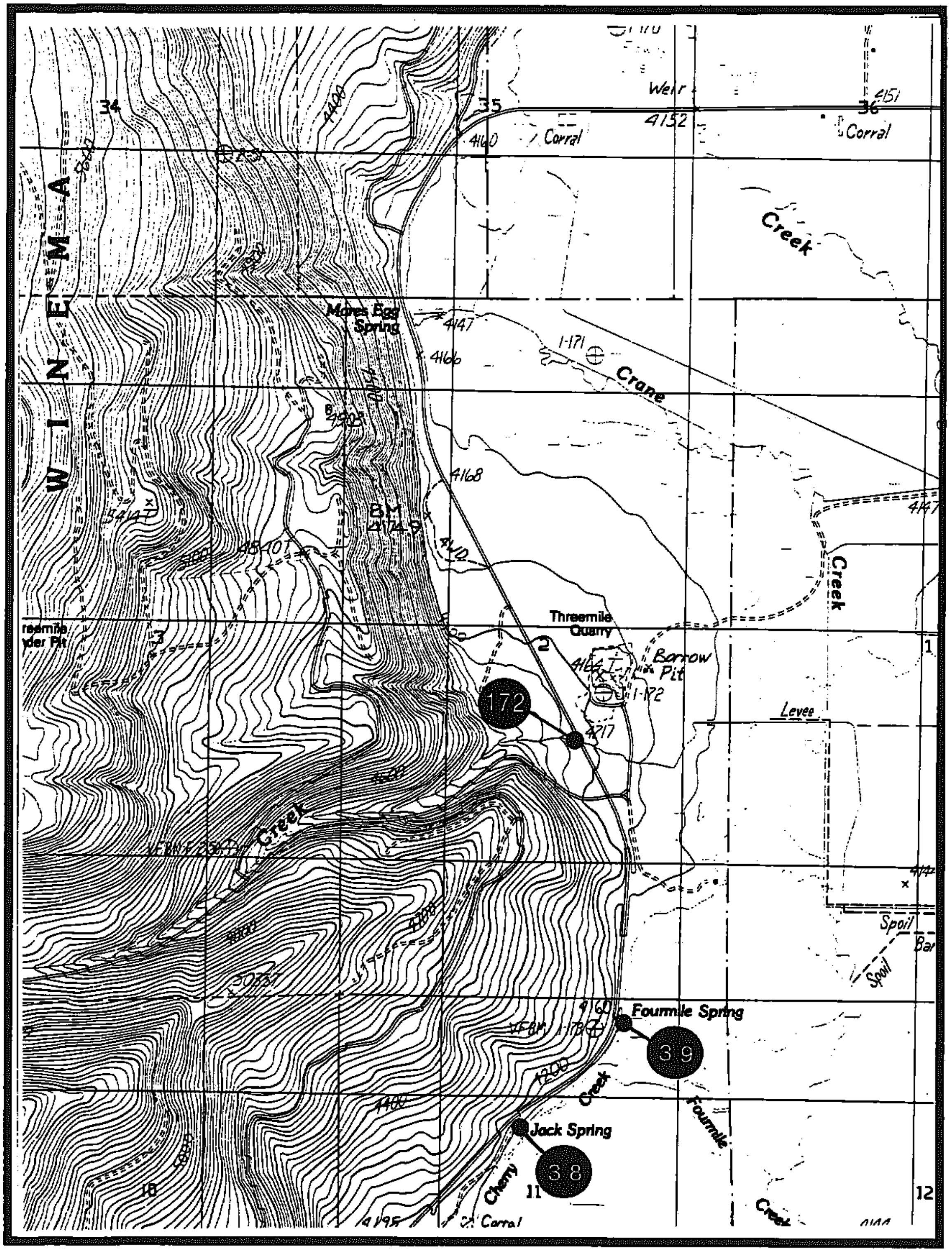
MARES EGG SPRING QUADRANGLE, KLAMATH CO., OR
SITES 25, 40, 41, 42, 43, 44, 68, 69, 70, 71, 155, 156, 286, 287

71 = Tiger .010
156 = Tiger .012
155 = Tiger .011
70 = Tiger .009

69 = Tiger .008
43 = Tiger .002
68 = Tiger .007
40 = Tiger .001

B67

25 = ∅
41 = ∅ ..
42, 44 = ∅ (combine 43)?
286 = ∅ 287 = ∅

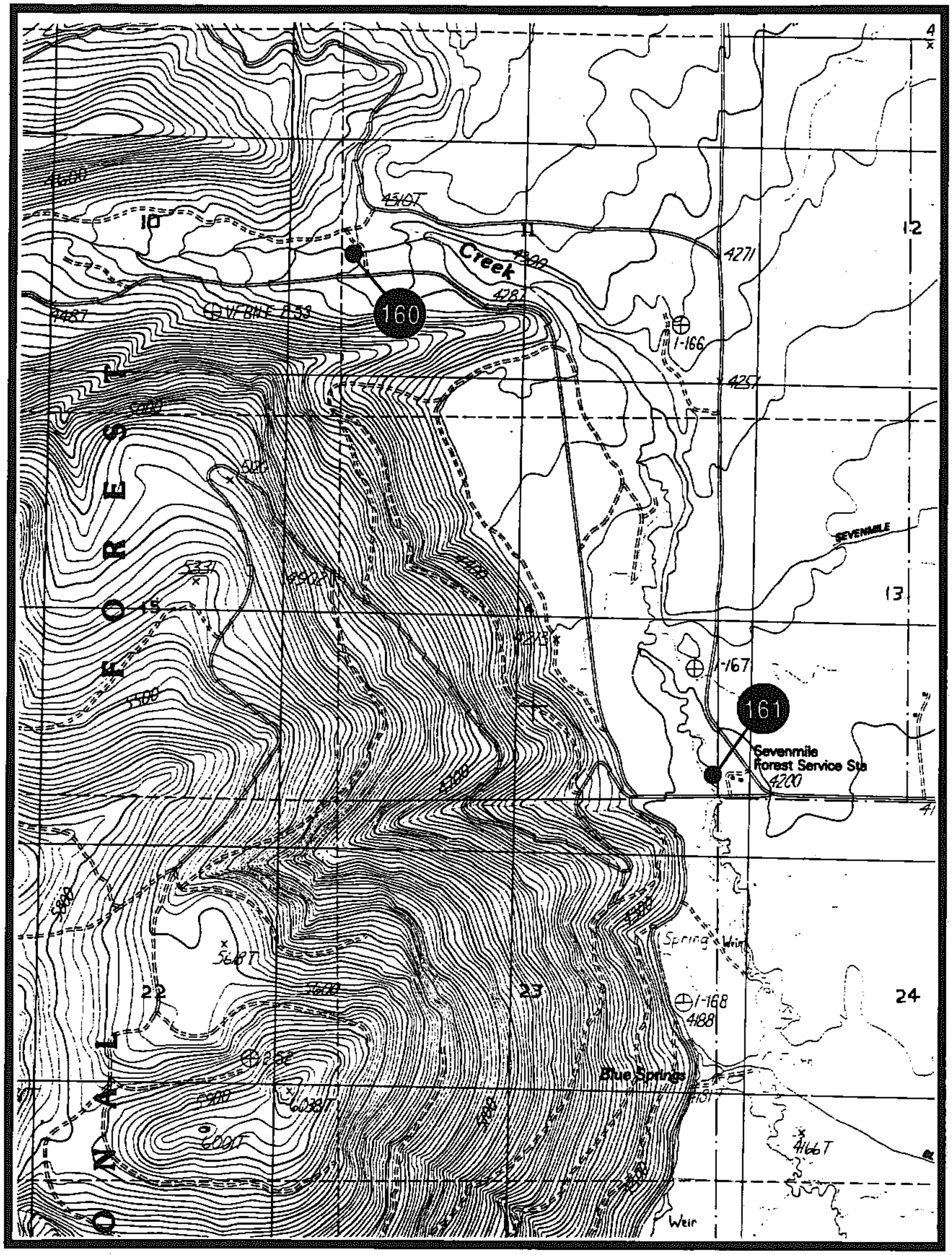


MARES EGG SPRING QUADRANGLE, KLAMATH CO., OR
SITES 38, 39, 172

172 = Ø
39 = Tiger .003
38 = Ø (may be = cot nov .006 / Tiger .005 / odessa .004 } not mapped exactly ~ JJ)

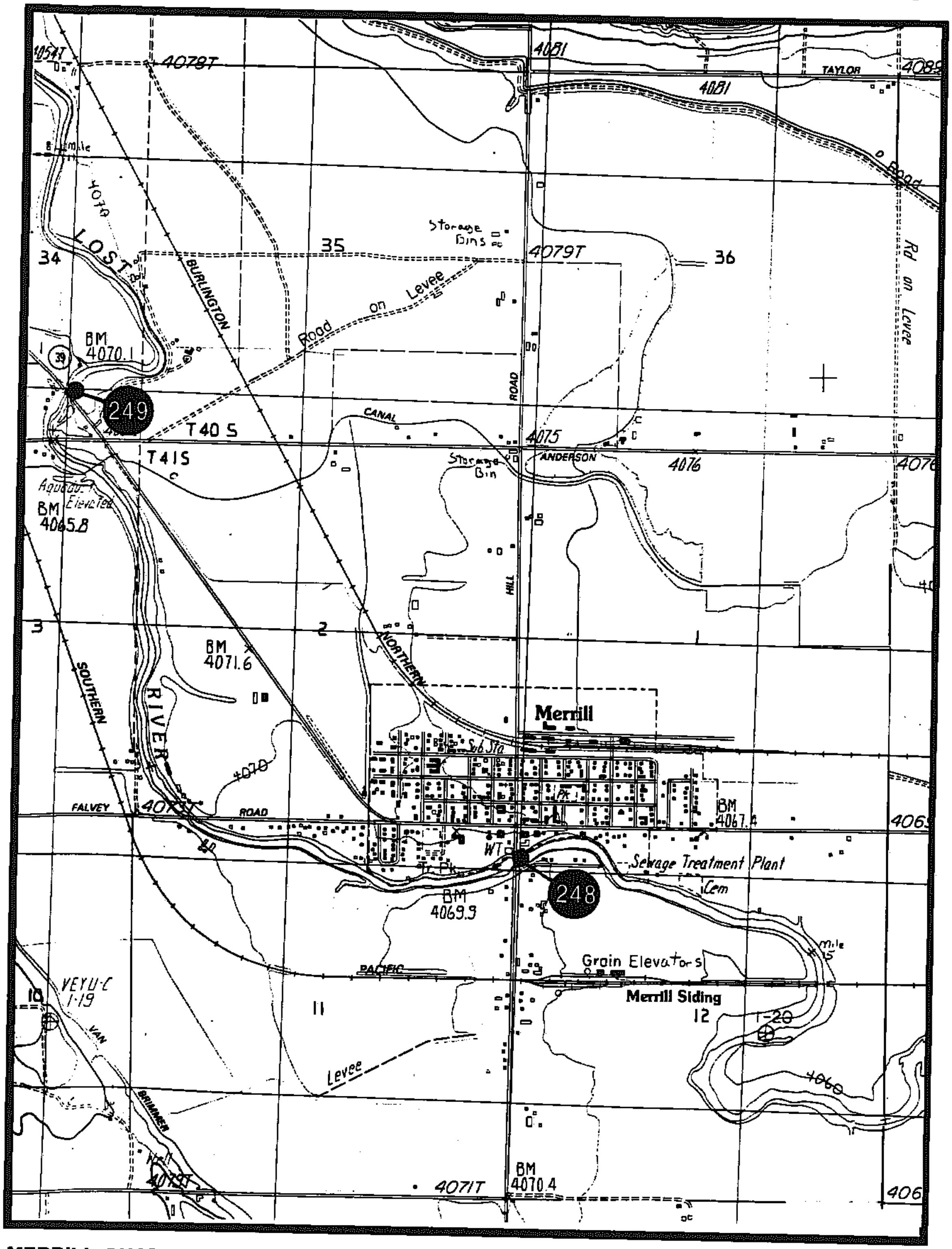
B68

√



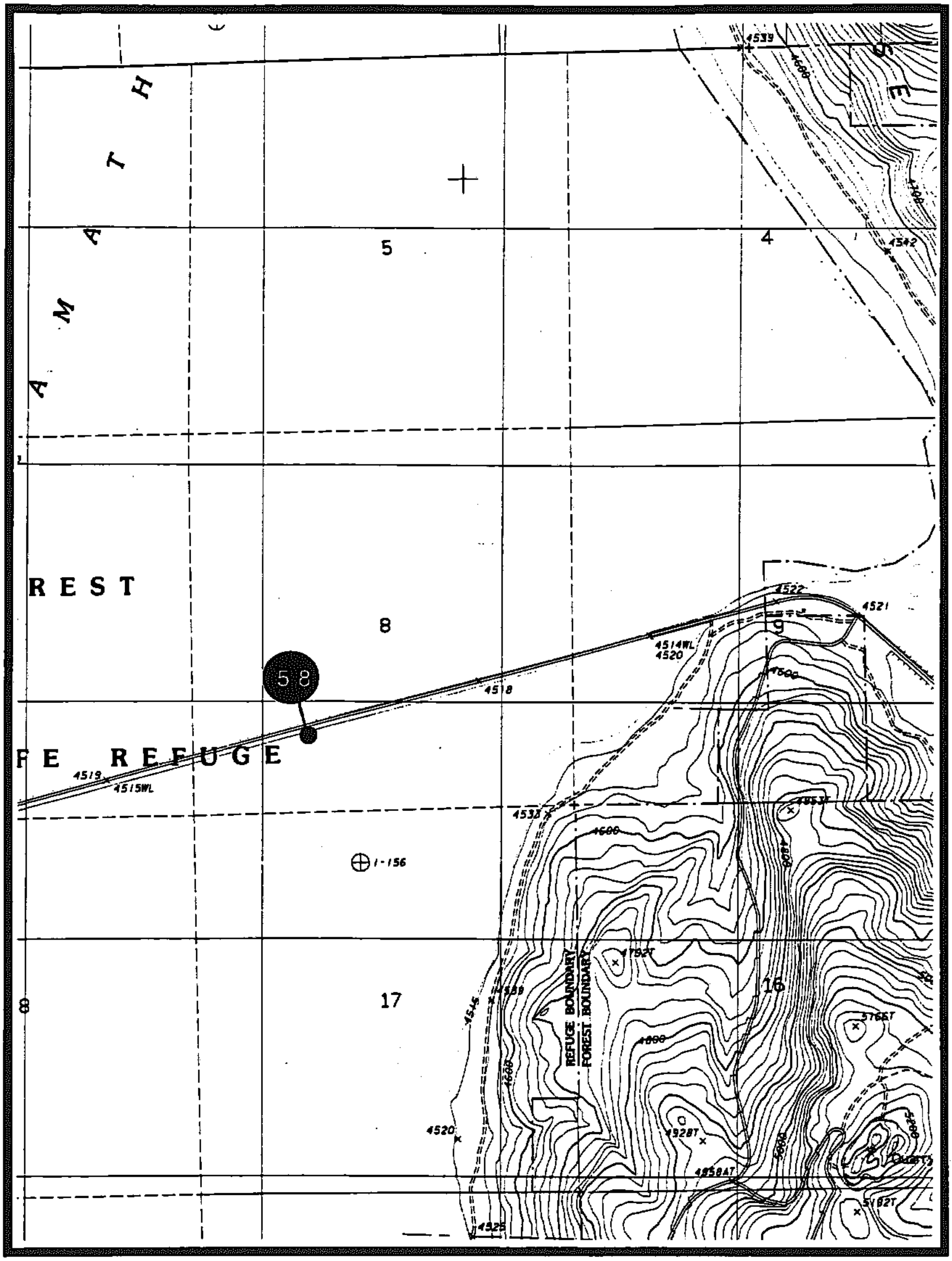
MARES EGG SPRING QUADRANGLE, KLAMATH CO., OR
SITES 160, 161 = ∅

42 P21 15



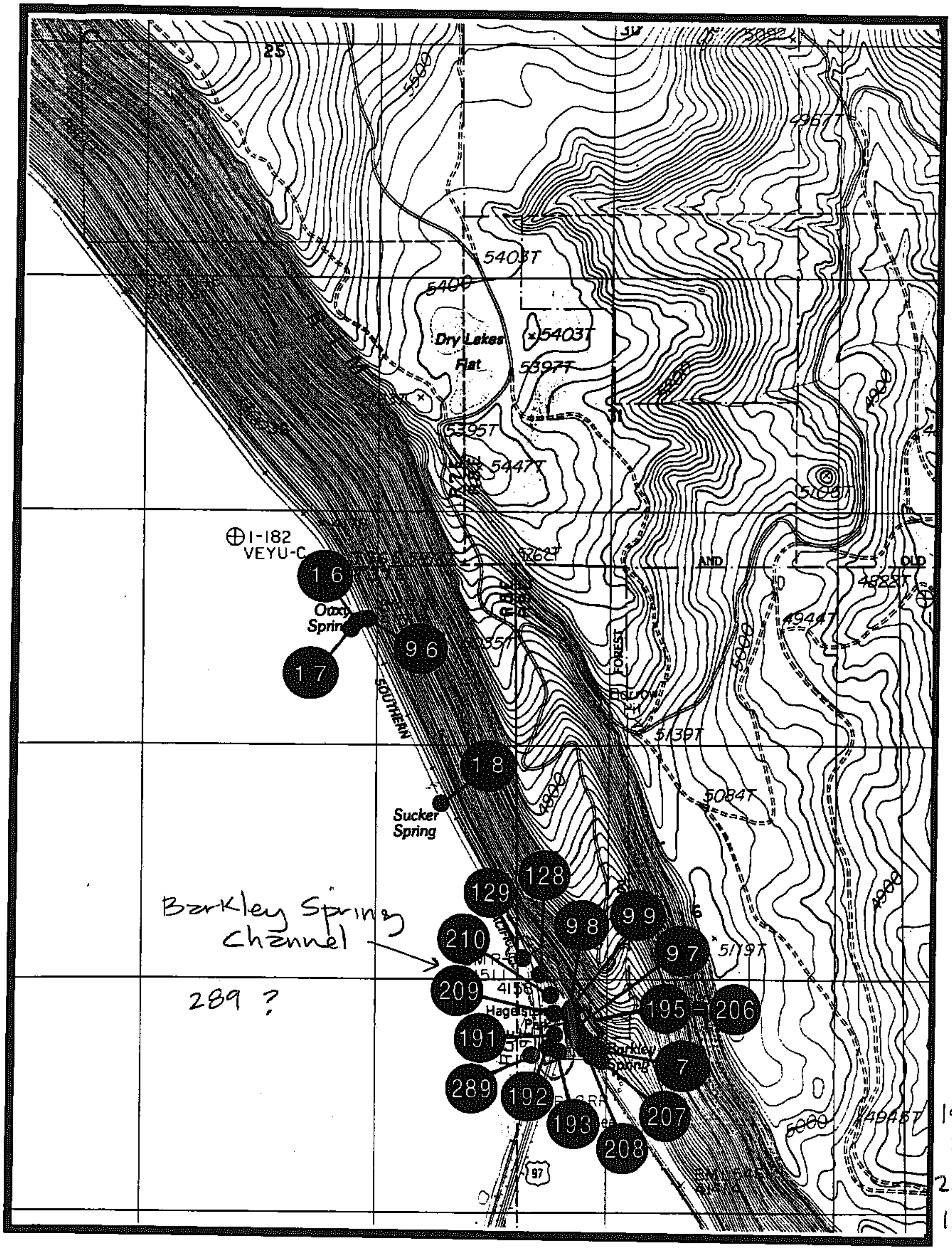
MERRILL QUADRANGLE, KLAMATH CO., OR
SITES 248, 249 = φ

42 12186 J.



MILITARY CROSSING QUADRANGLE, KLAMATH CO., OR
SITE 58 = ∅

42 121 47 √



18 = ϕ
cat lux ?

191-193 = ϕ
289 = ϕ
209, 210 = ϕ
128 = ϕ

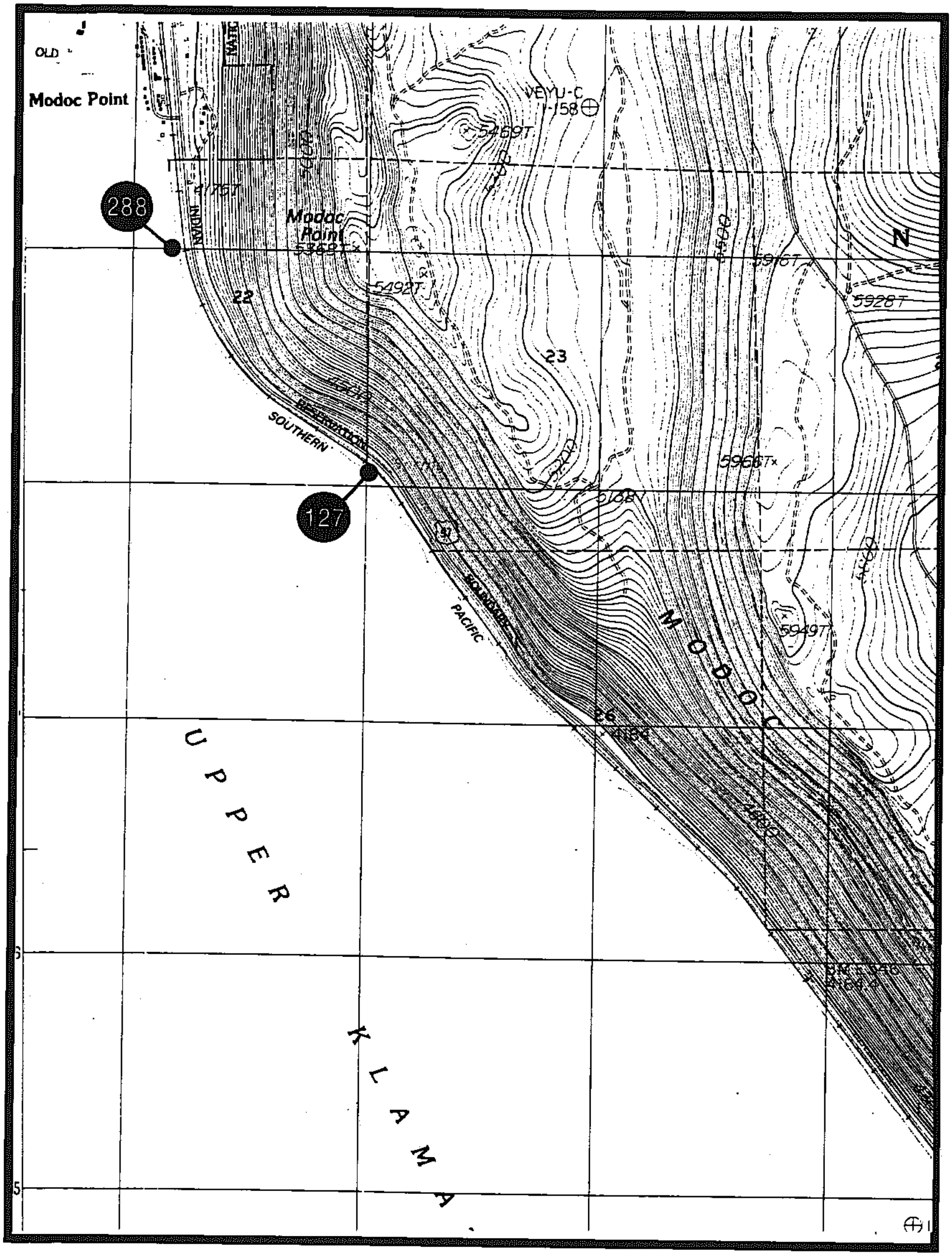
MODOC POINT QUADRANGLE, KLAMATH CO., OR (see also Figure 2)
SITES 7, 16, 17, 18, 96, 97, 98, 99, 128, 129, 191, 192, 193, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 289

B72

○ = crk crk .002
Lan kla .002
vor k. sin .001
mares .006

129 = klamath .010
pis ult .009
pyr arc .004
vor kla kla .004

16, 17, 96 = pis ult .008
Klamath .007
ouxy .001
nodose .002
pyr arc .003



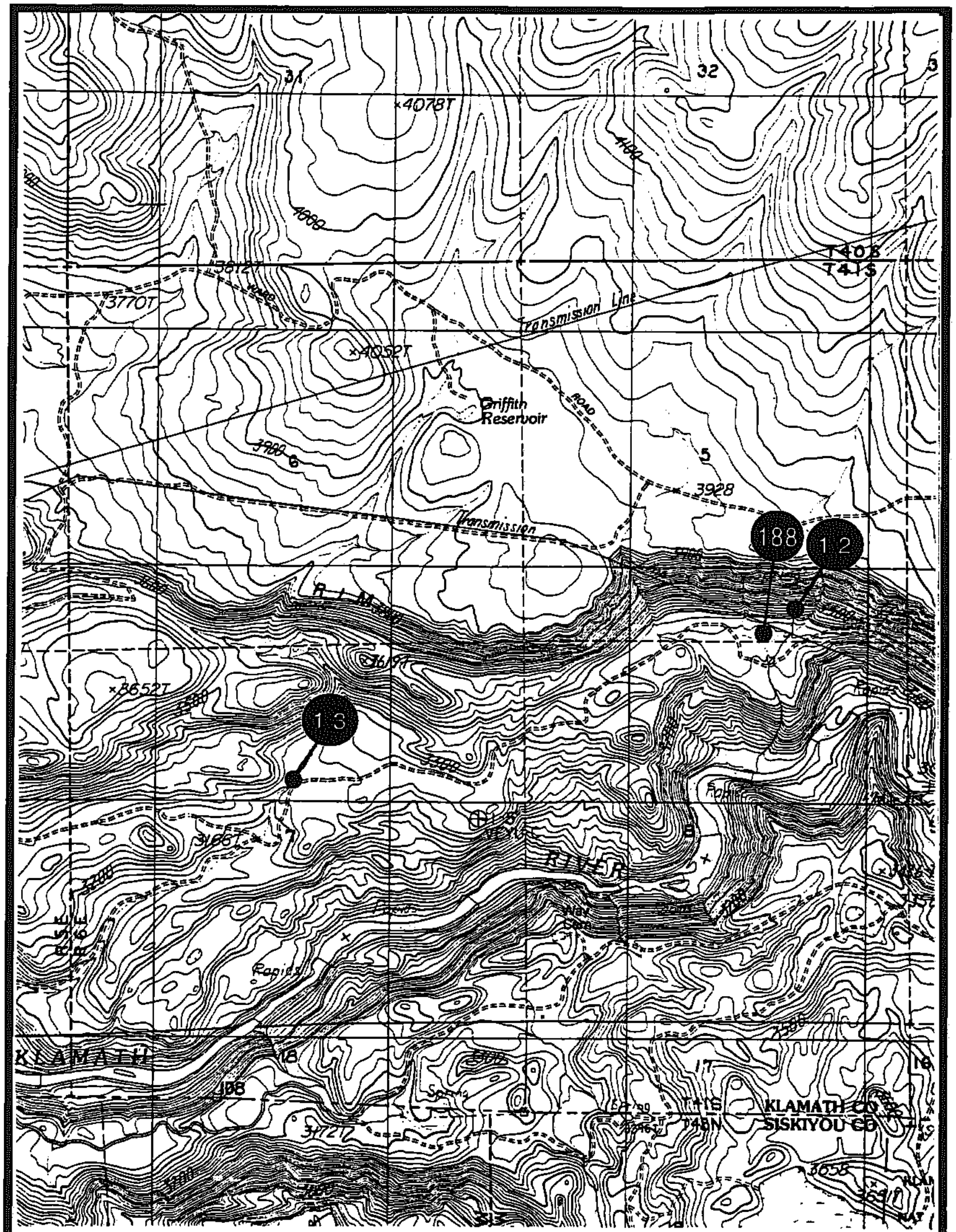
MODOC POINT QUADRANGLE, KLAMATH CO., OR
SITES 127, 288

288 = ∅

127 = nodosc .003
Klamath .009
var kla kla .003

B73

42 12212

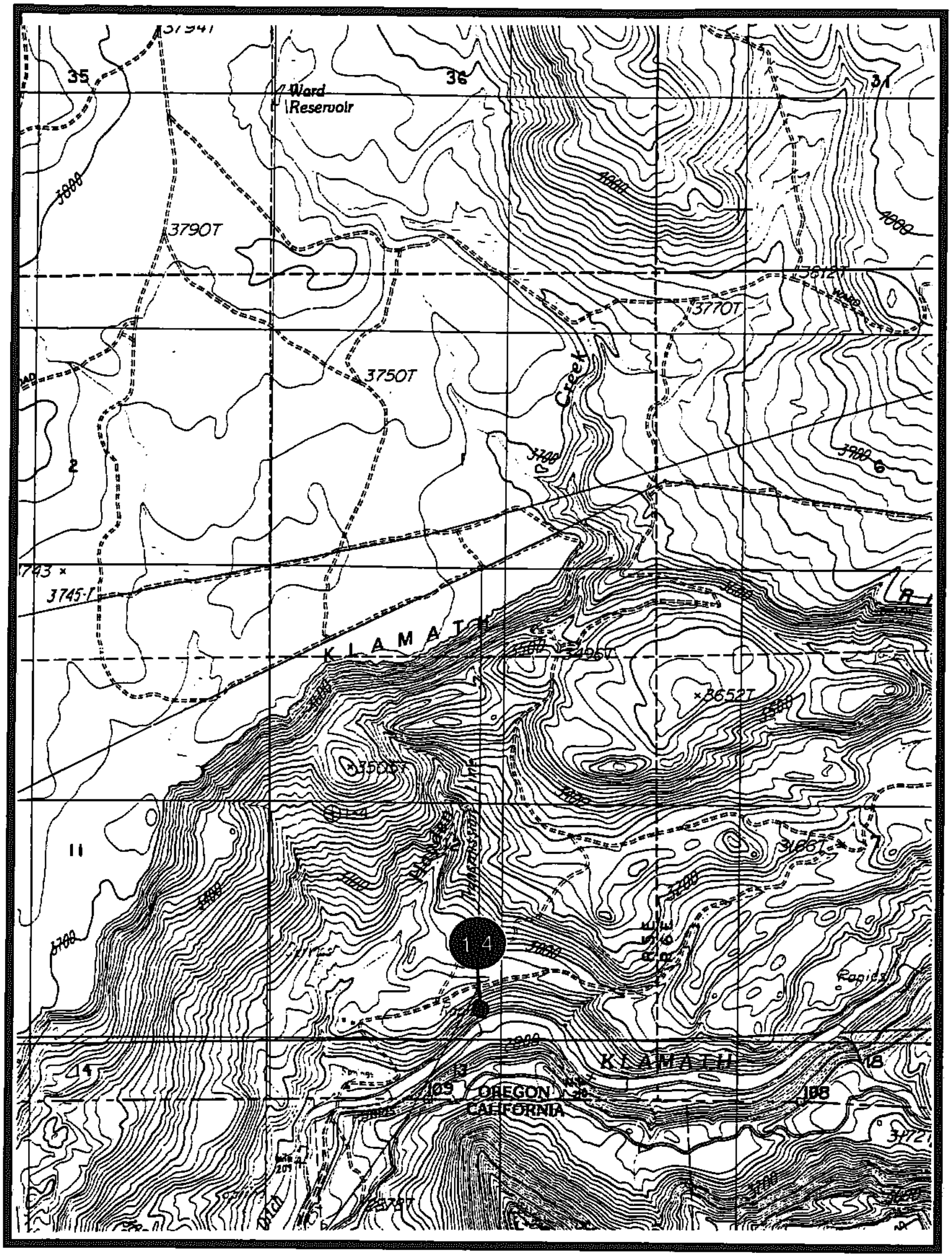


MULE HILL QUADRANGLE, KLAMATH CO., OR
SITES 12, 13, 188

12 = Klam. rim .001

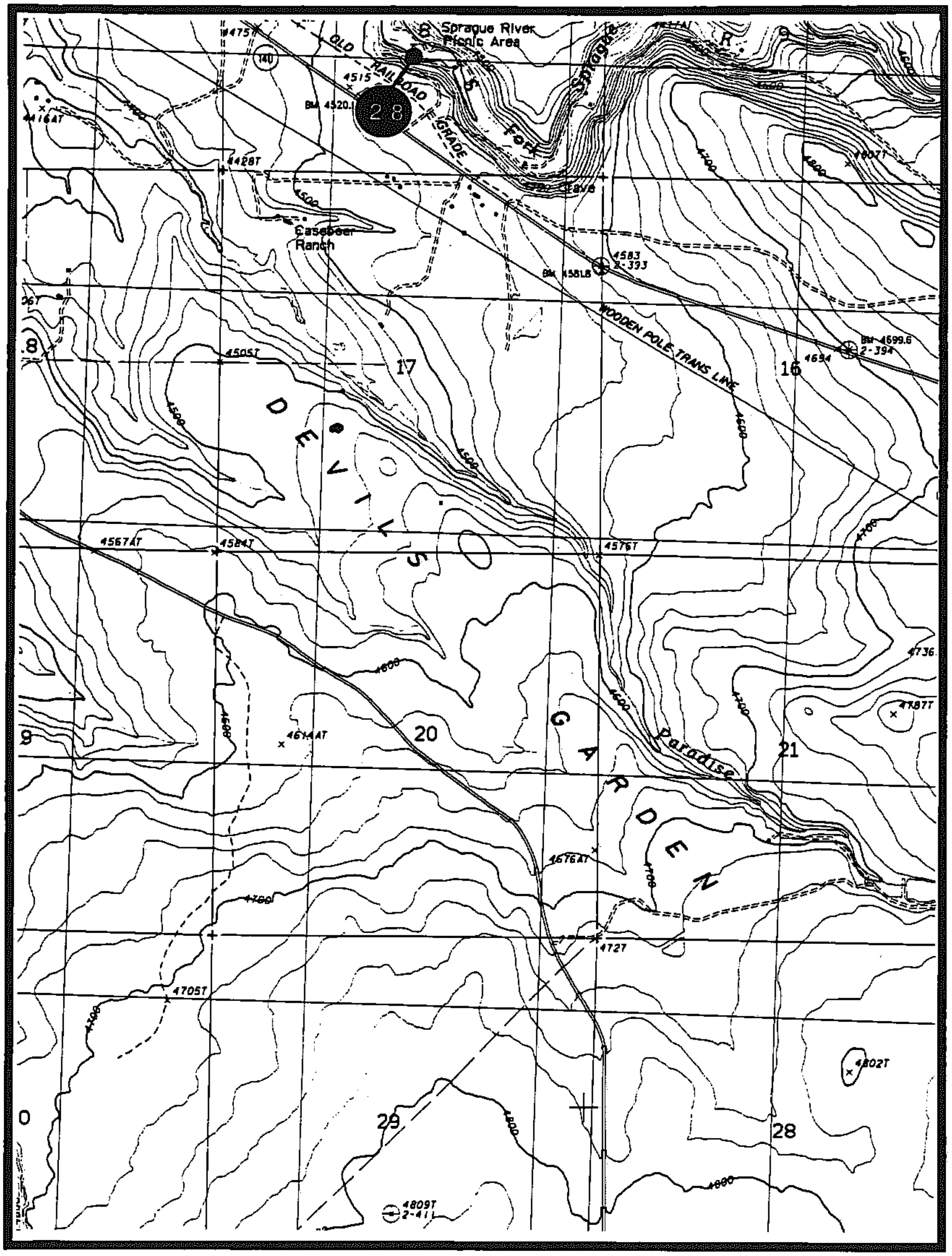
188, 13 = ∅

B74



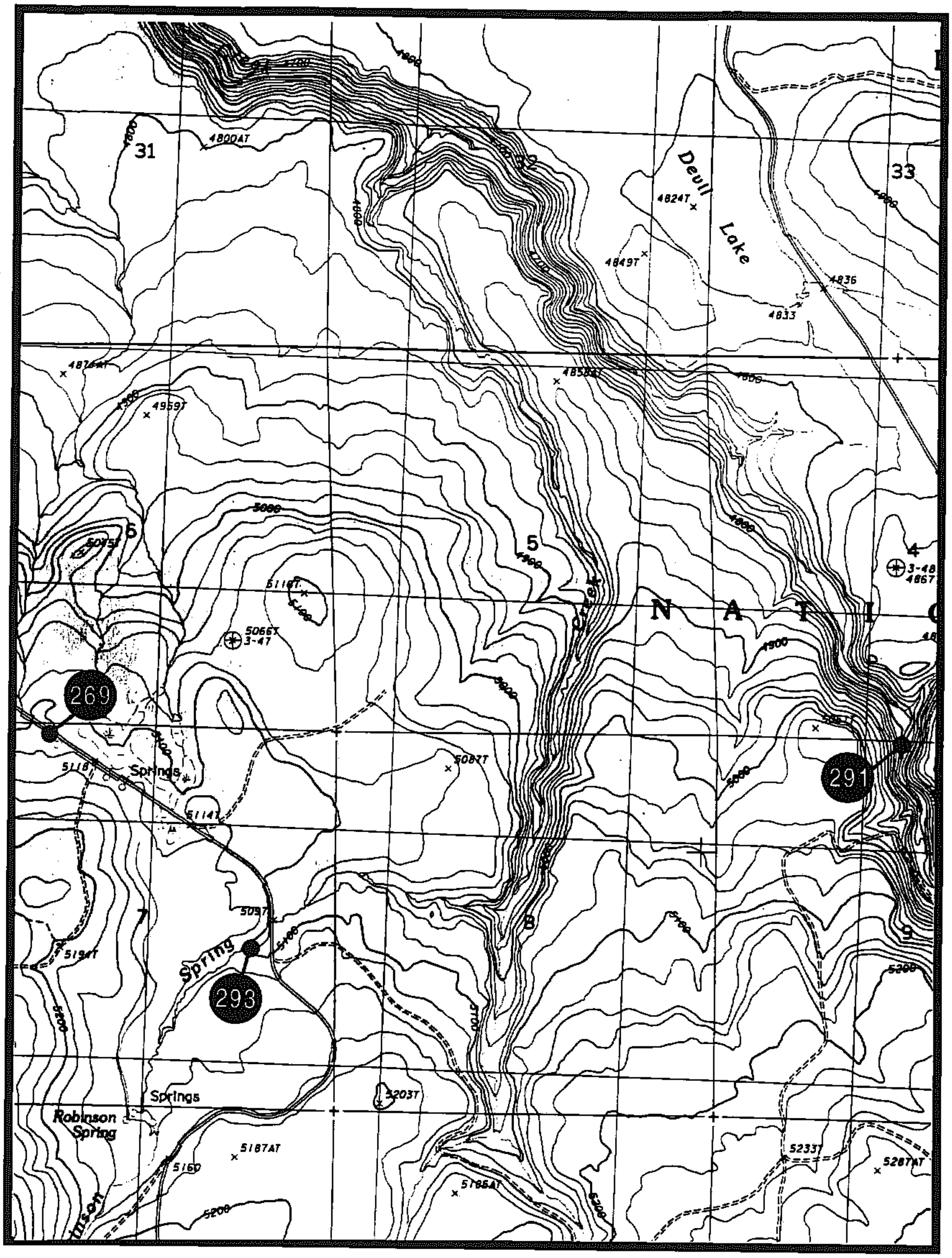
MULE HILL QUADRANGLE, KLAMATH CO., OR
SITE 14 = Φ

42120 38 ✓



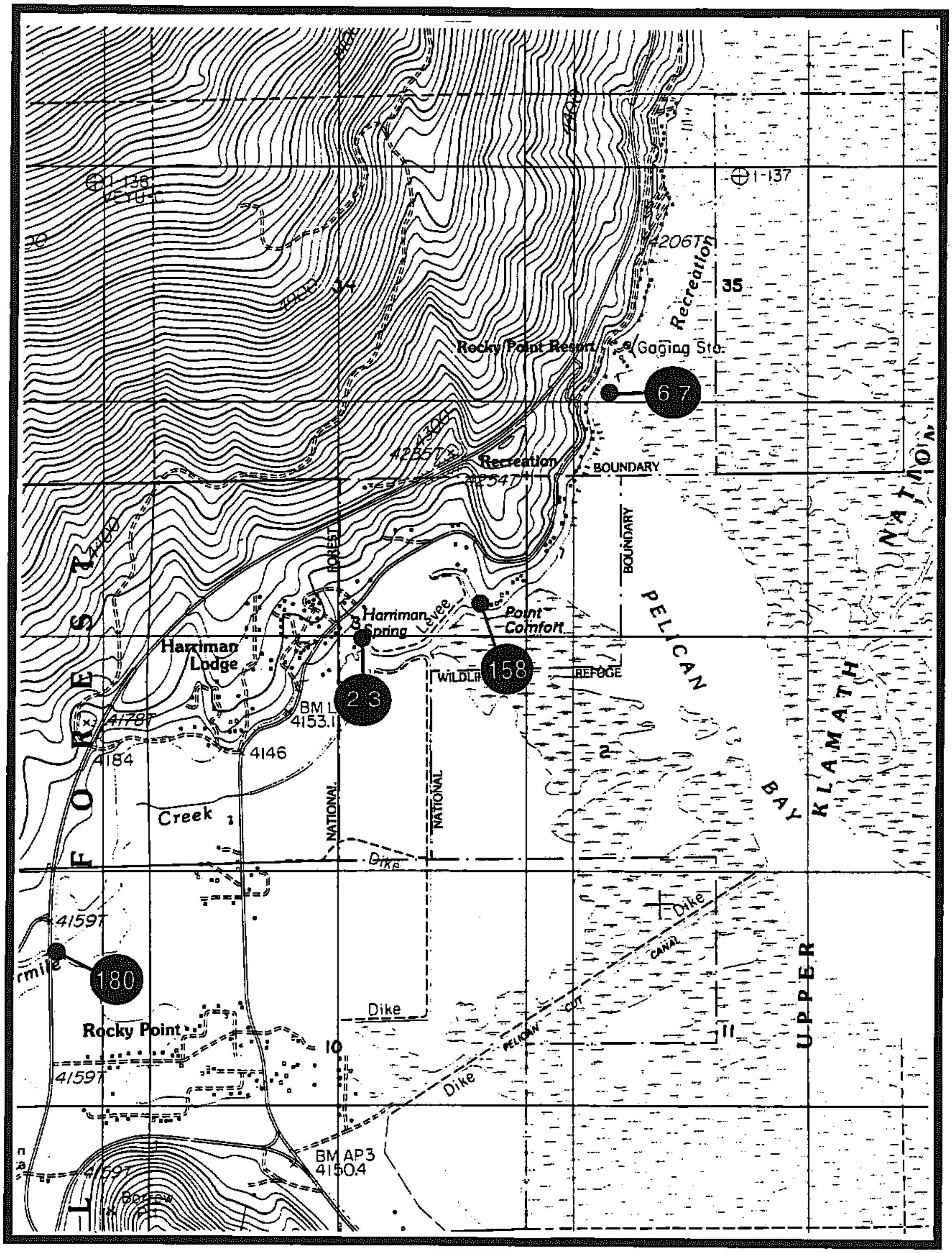
PARADISE MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITE 28 = mar fal .001

√



PARADISE MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITES 269, 291, 293 = ⌀

42 122 41



PELICAN BAY QUADRANGLE, KLAMATH CO., OR
SITES 23, 67, 158, 180

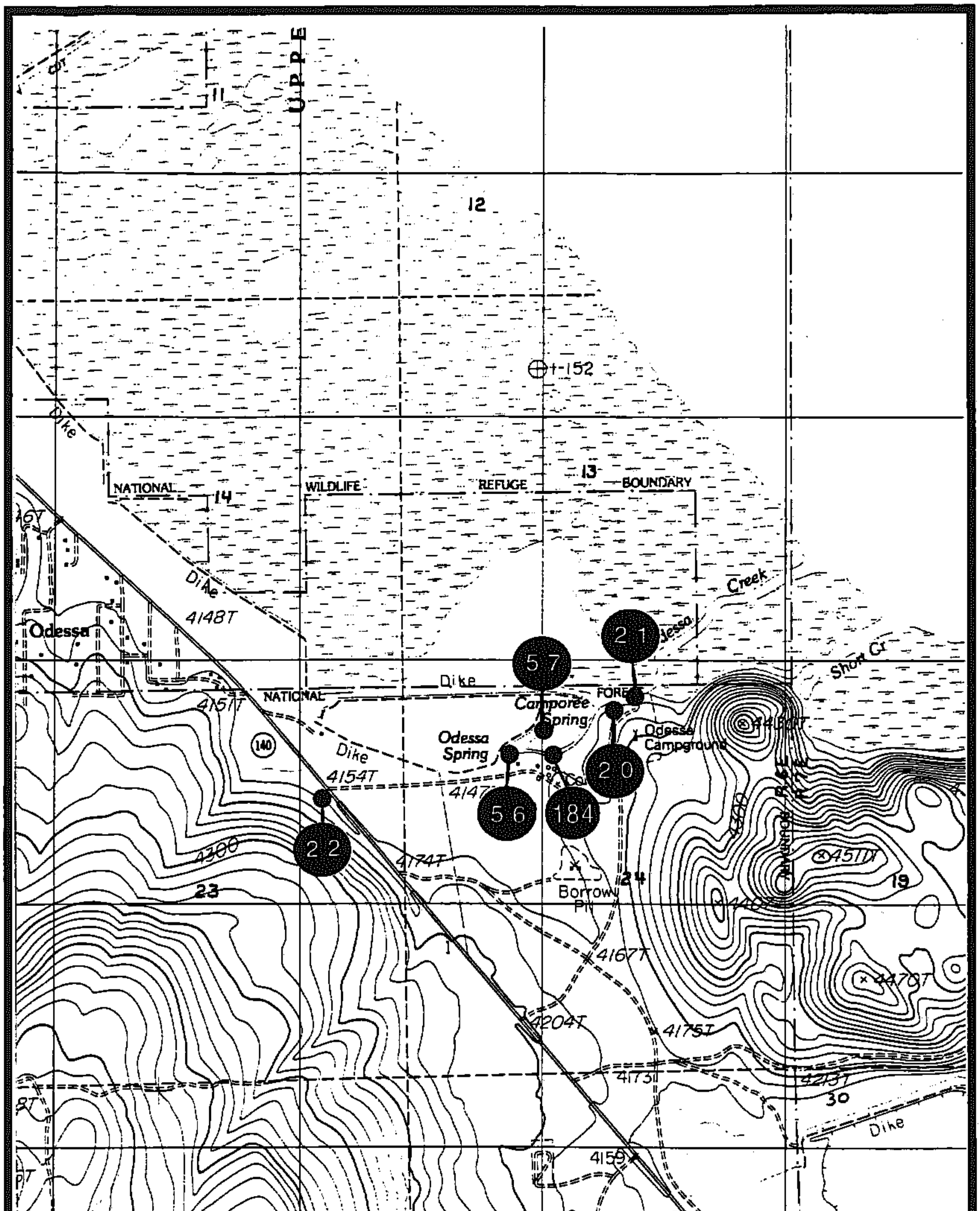
23 = tall .001
odessa .003
lan Kla .005
Mares .004

67 = Klamath .006
Vor Kla Kla .002

B78

158 = Vor Kla Kla .007

180 = ∅



PELICAN BAY QUADRANGLE, KLAMATH CO., OR
SITES 20, 21, 22, 56, 57, 184

184 = ∅
56 = ∅
22 = ∅

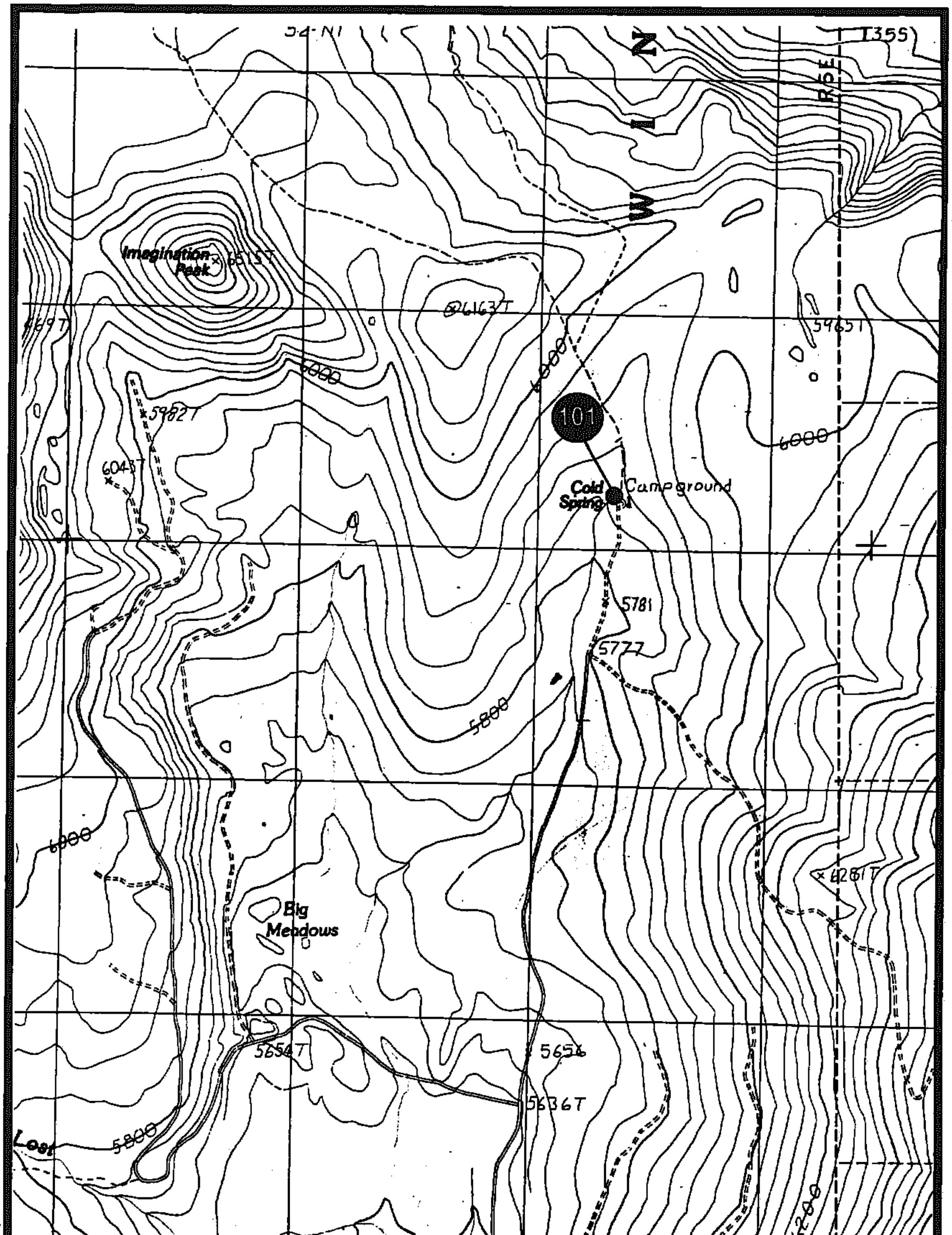
21 = odessa .002
ano cal .006
lan alt .002

20 = odessa .001

57 = Klamath .004
lan Kla .004

B79

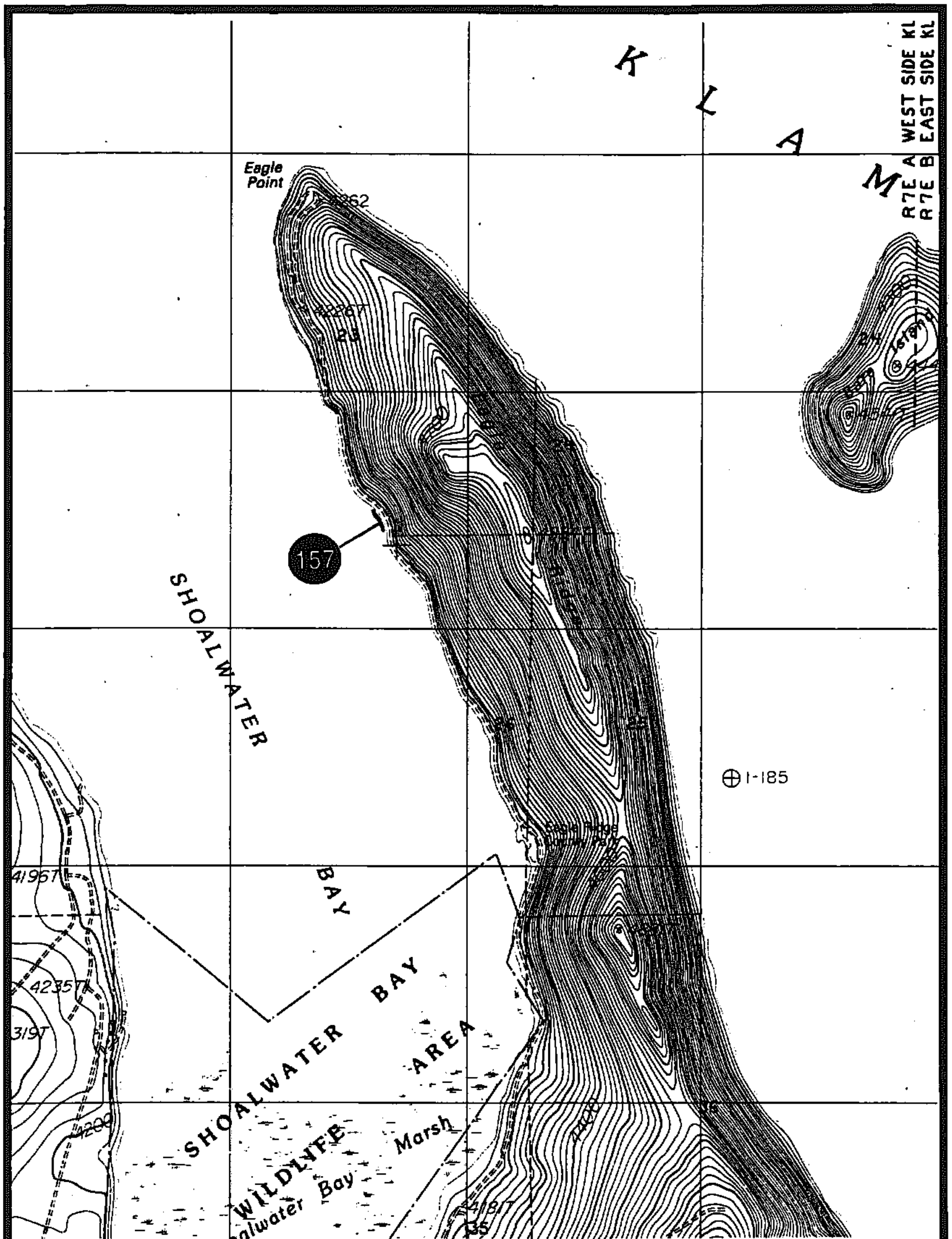
42 12252



PELICAN BUTTE QUADRANGLE, KLAMATH CO., OR
SITE 101 = Ø

B80

42 12148 ✓

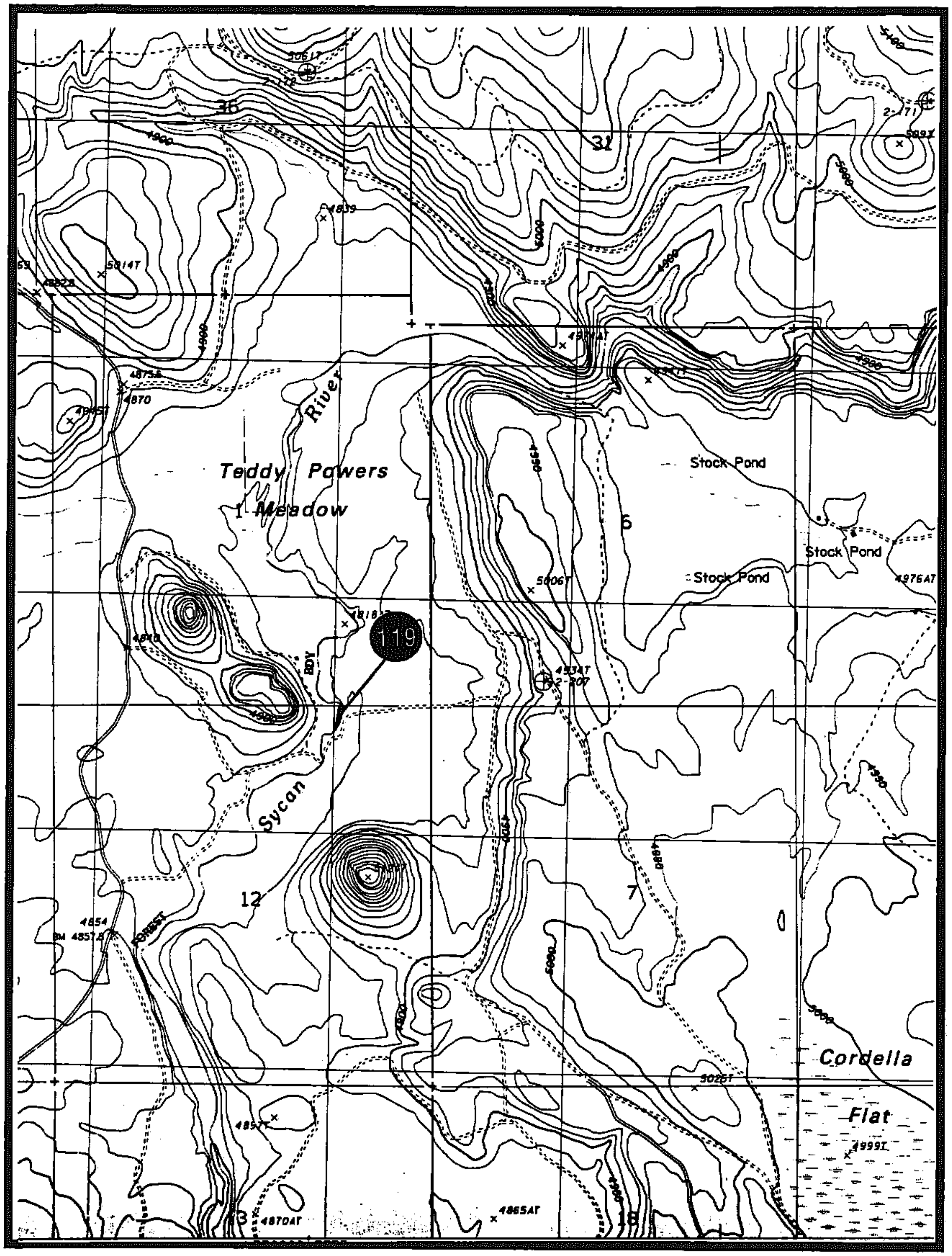


SHOALWATER BAY QUADRANGLE, KLAMATH CO., OR
SITE 157 = Klamath .012
pyr arc .005
pis ult .010
vor kla kla .006
vor eff dal .004 (this may be on Bare Island)

B81

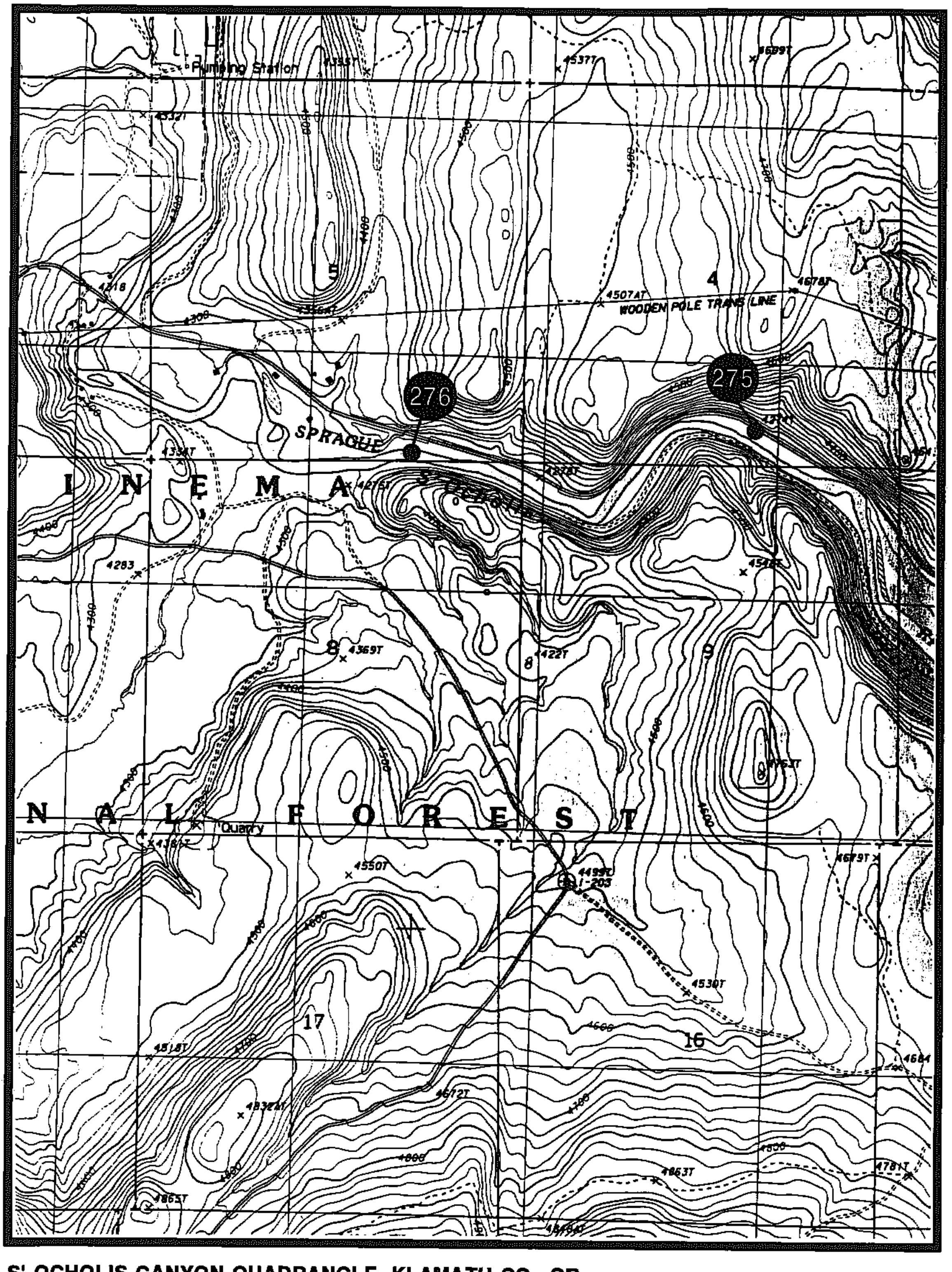
map margin: too hard to read

4212163 √



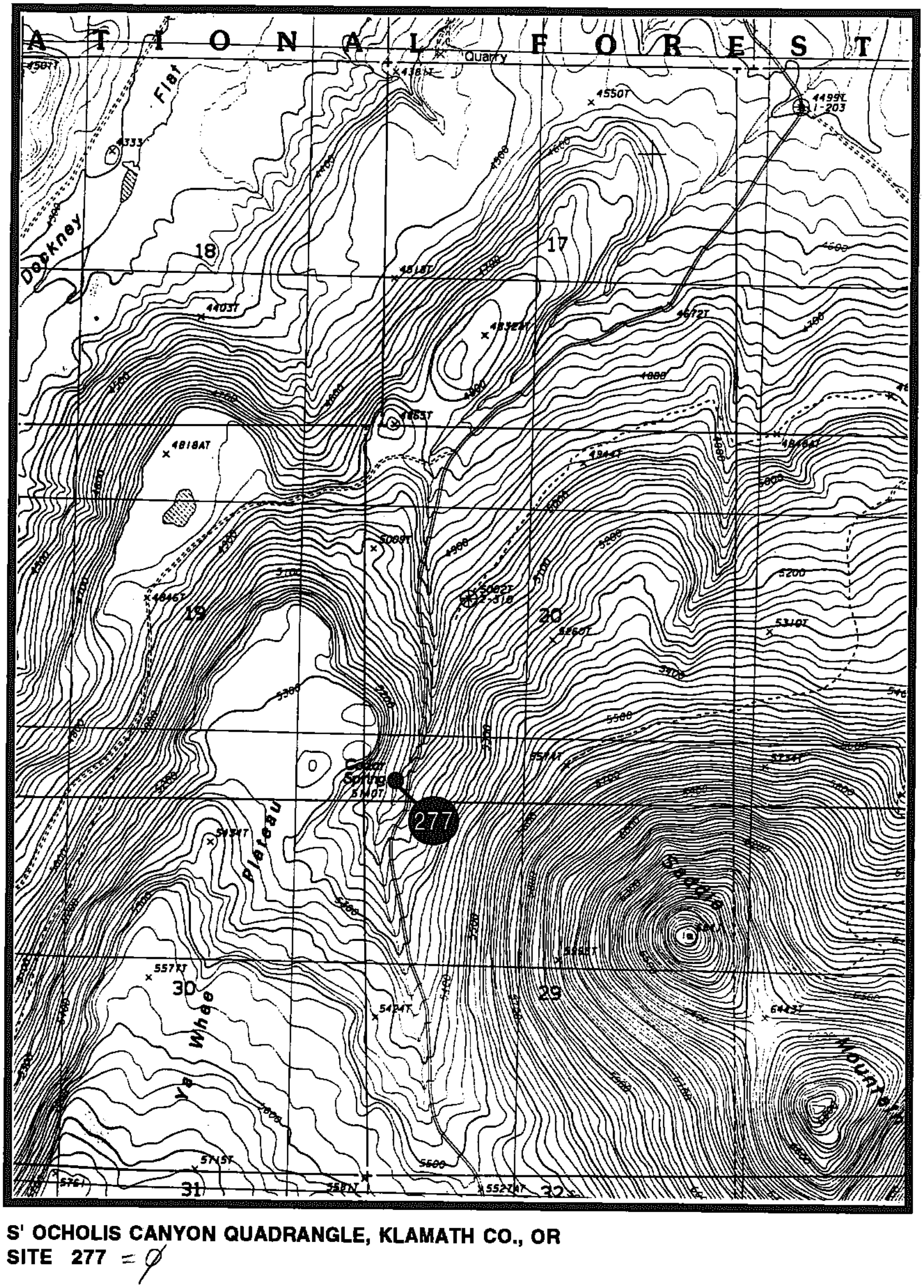
SILVER DOLLAR FLAT QUADRANGLE, KLAMATH & LAKE COS., OR
SITE 119 =∅

42 121 56 √



S' OCHOLIS CANYON QUADRANGLE, KLAMATH CO., OR
SITES 275, 276 = ∅

B83



S' OCHOLIS CANYON QUADRANGLE, KLAMATH CO., OR
SITE 277 = Ø

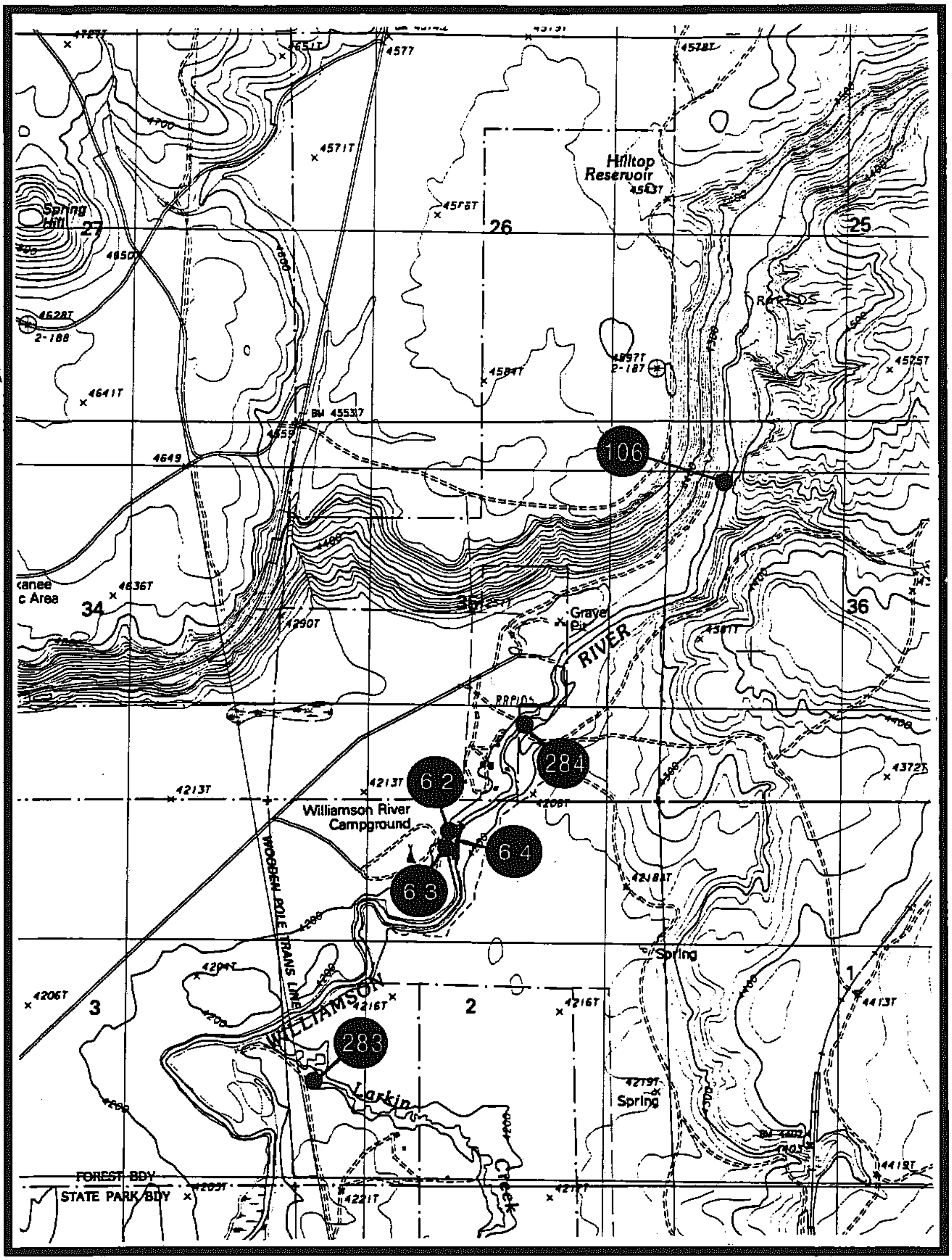
B84

delete Lanx Kla .003 (supposed to be Lanx alta) 42 121 67 √

none
64 = crk crk
new Lanxalta
new Klam Lyg

63 = Wood

remap crk crk .003
delete Lanx Kla
delete crk crk .017



map at 284

SOLOMAN BUTTE QUADRANGLE, KLAMATH CO., OR
SITES 62, 63, 64, 106, 283, 284

284 = ∅
283 = ∅

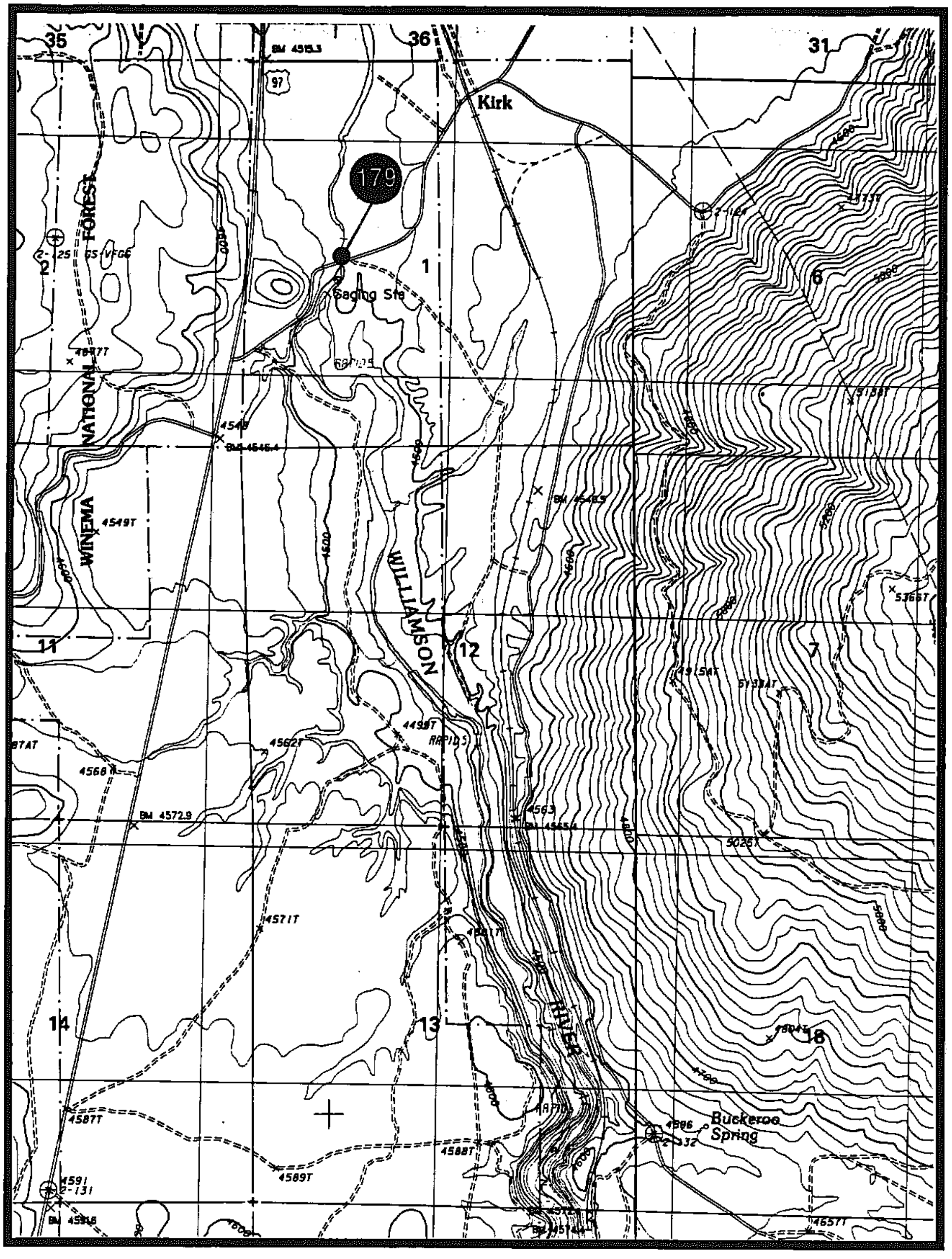
63 = crk crk .003 = 64
Lan Kla .003?
Gon ang .001
mar fal .002
wood river .008

106 = crk crk .017

B85

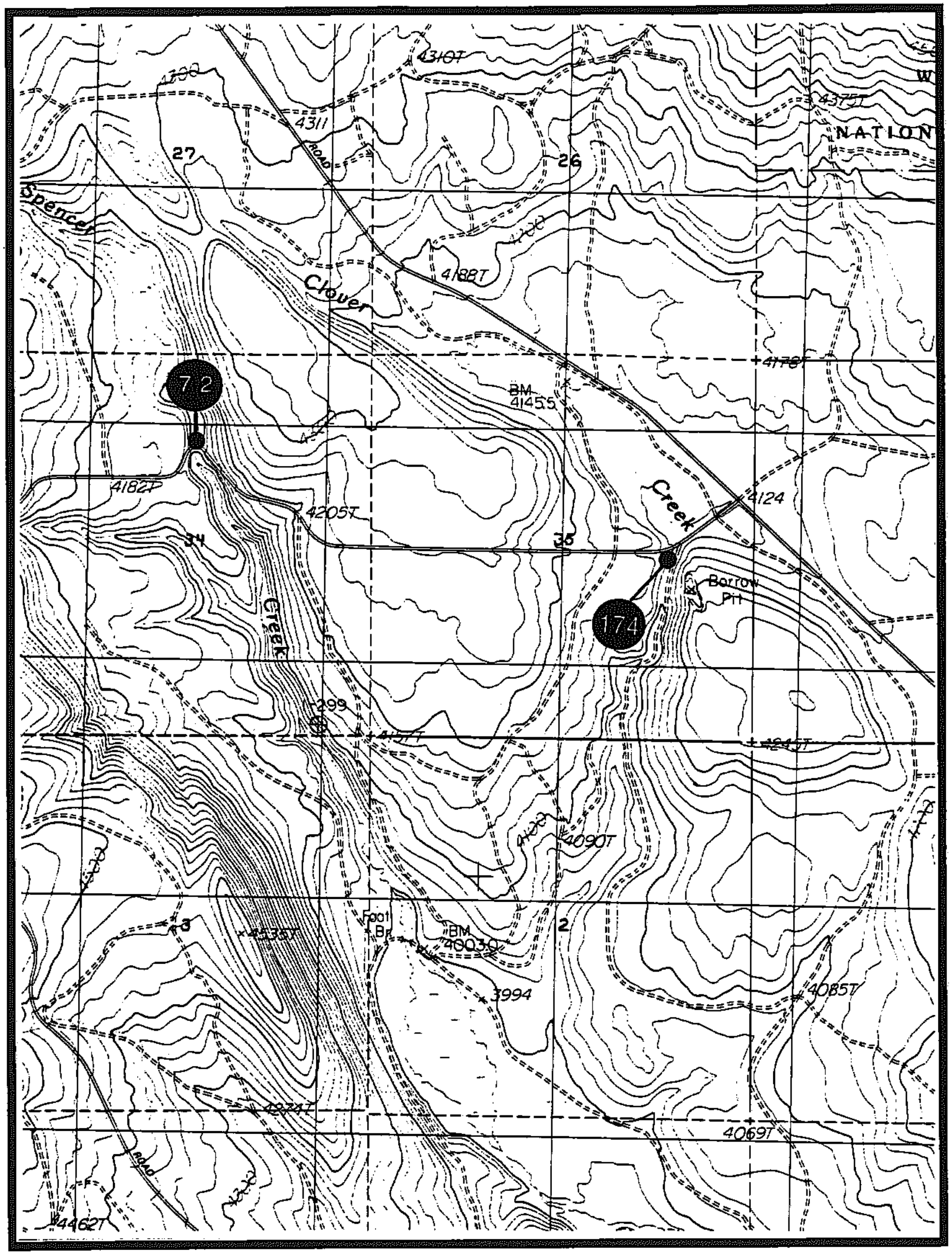
62, 64 = ∅ ? combine w/ 63

pull out
284 = 64



SOLOMAN BUTTE QUADRANGLE, KLAMATH CO., OR
SITE 179 = φ

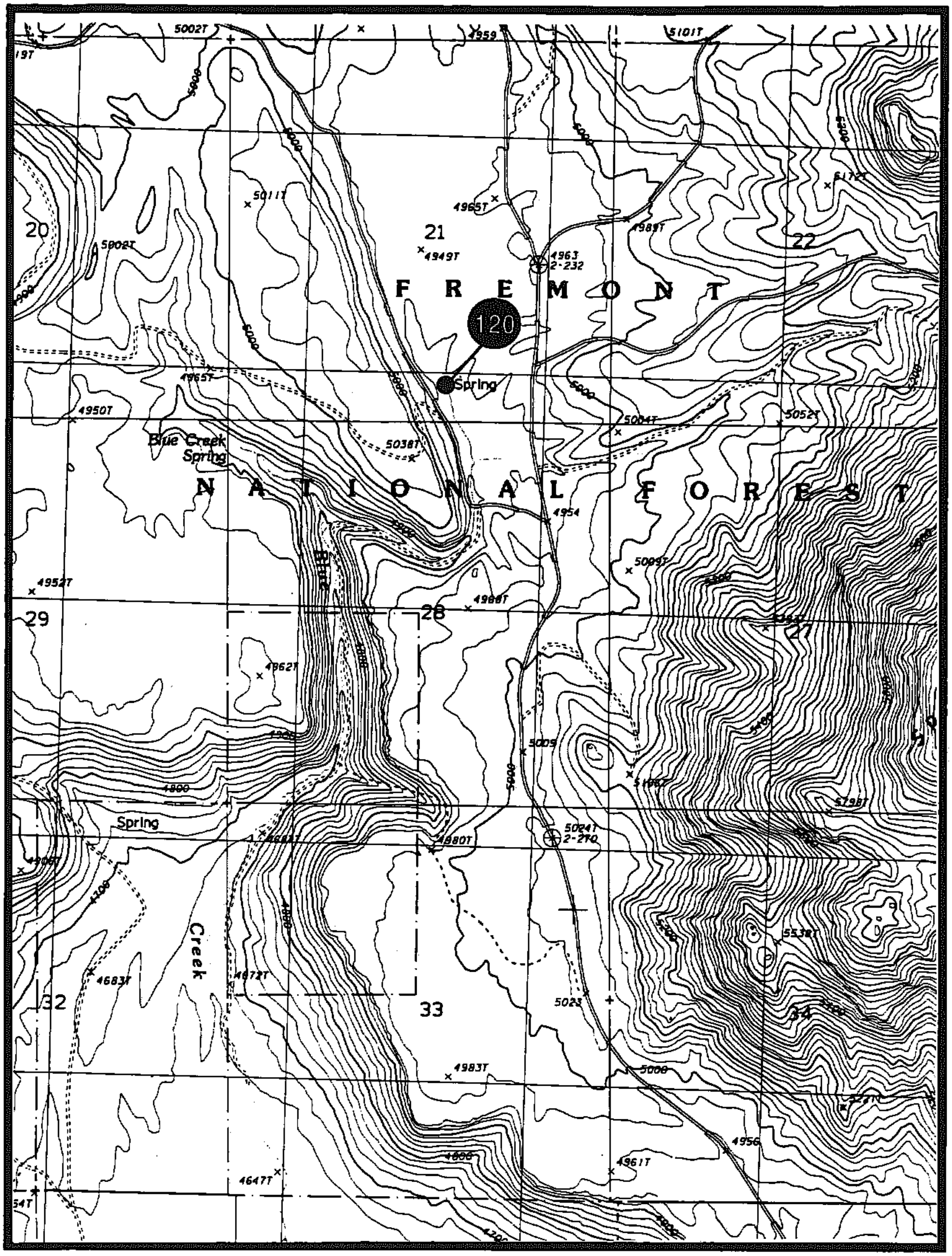
42 12 2 21 ✓



SPENCER CREEK QUADRANGLE, KLAMATH CO., OR
SITES 72, 174 = ∅

B87

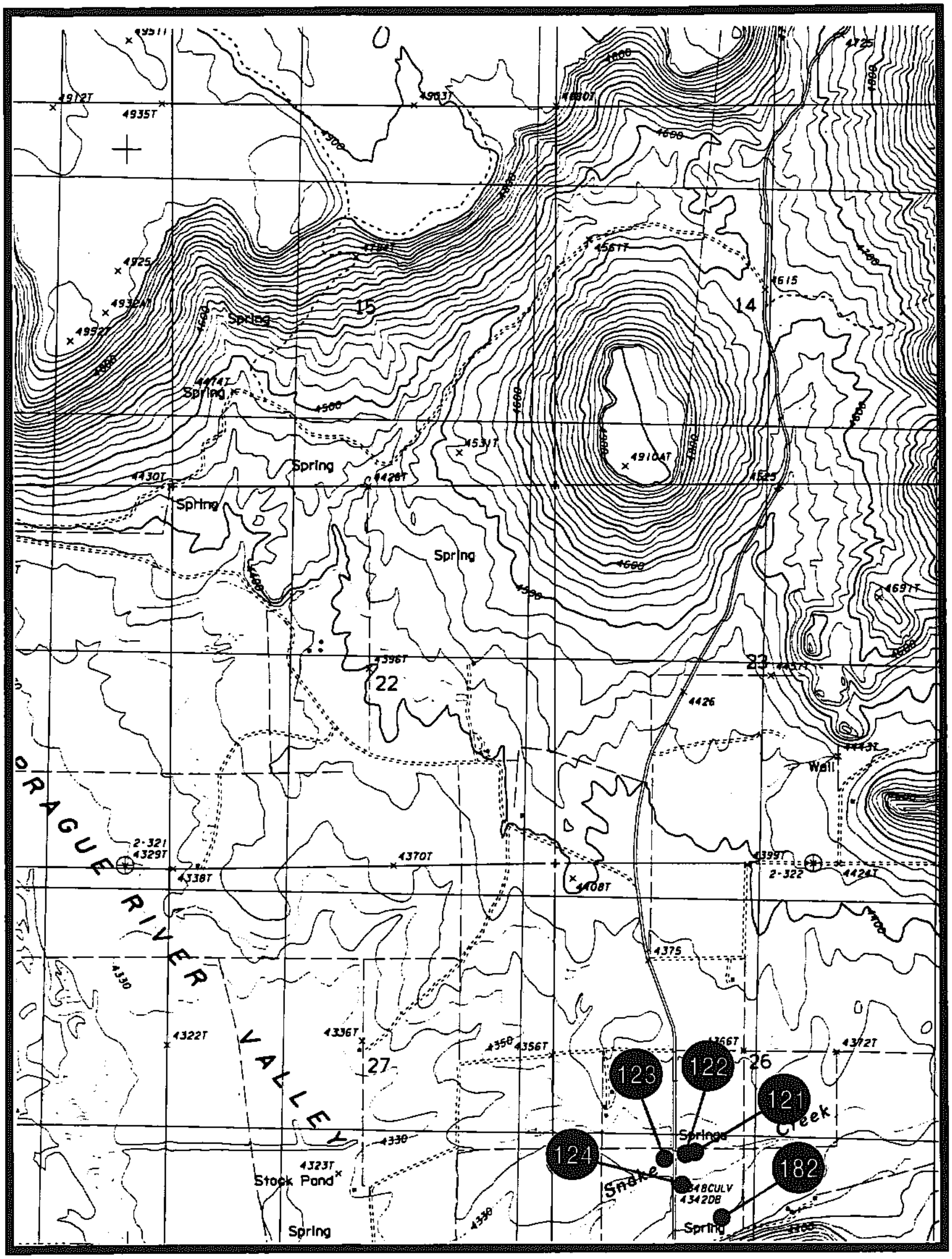
42 121 53 ✓



SPODUE MTN. QUADRANGLE, KLAMATH CO., OR
SITE 120 = ⌀

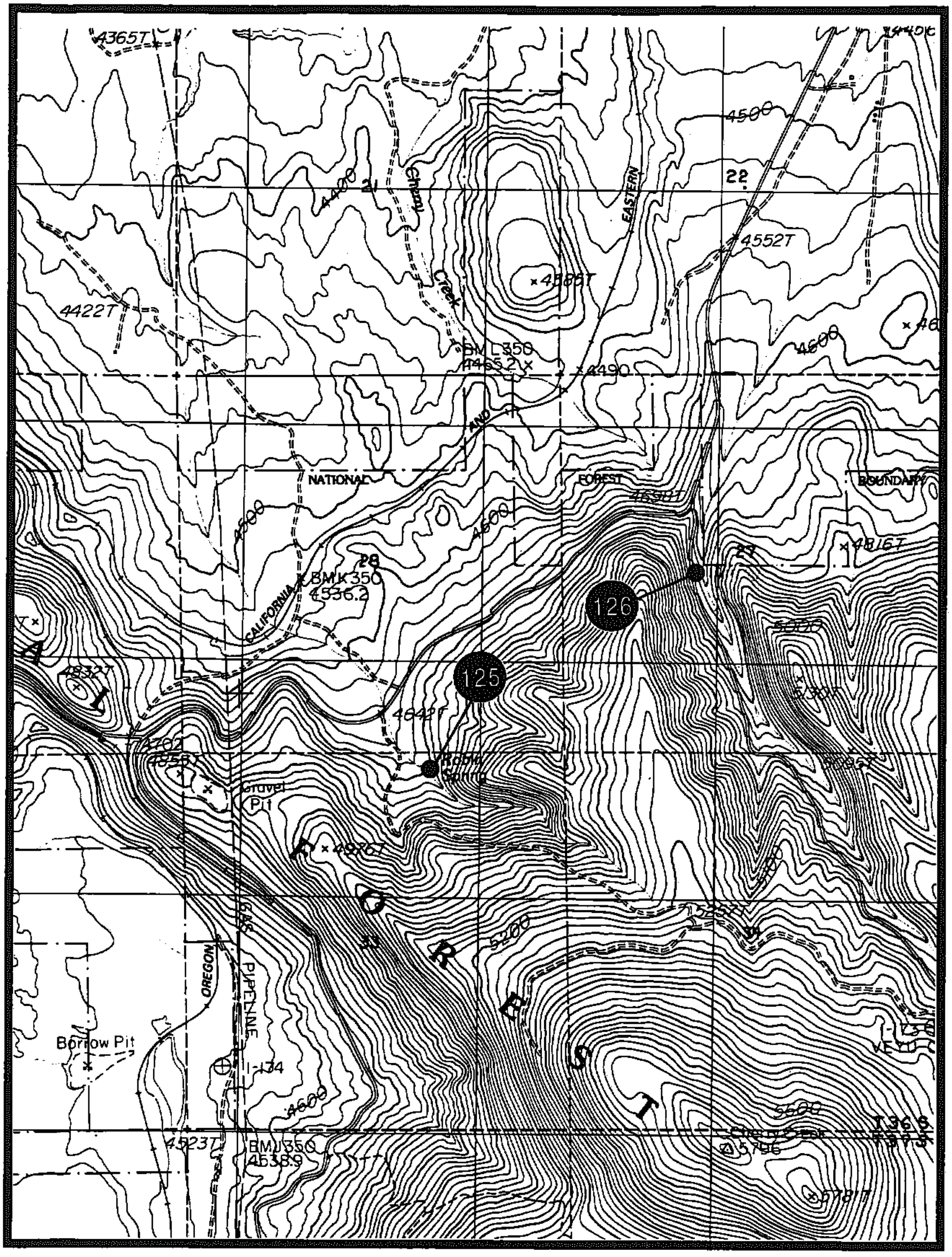
B88

J



SPODUE MTN. QUADRANGLE, KLAMATH CO., OR
SITES 121, 122, 123, 124, 182 = φ

42 121 46 √



SPRAGUE RIVER WEST QUADRANGLE, KLAMATH CO., OR
SITES 125, 126 = ∅

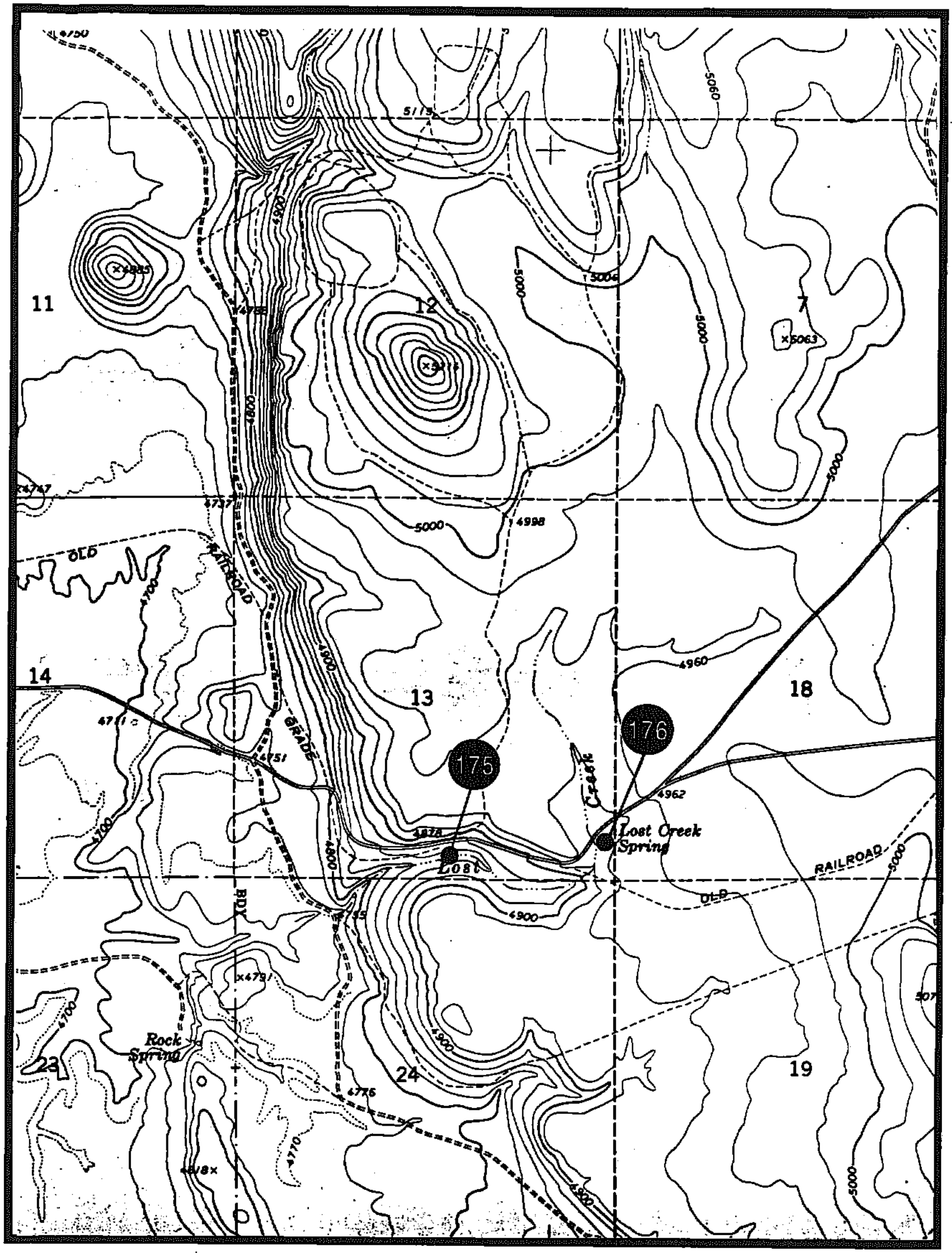
B90

√

SPRAGUE RIVER WEST QUADRANGLE, KLAMATH CO., OR
SITE 273 = Ø

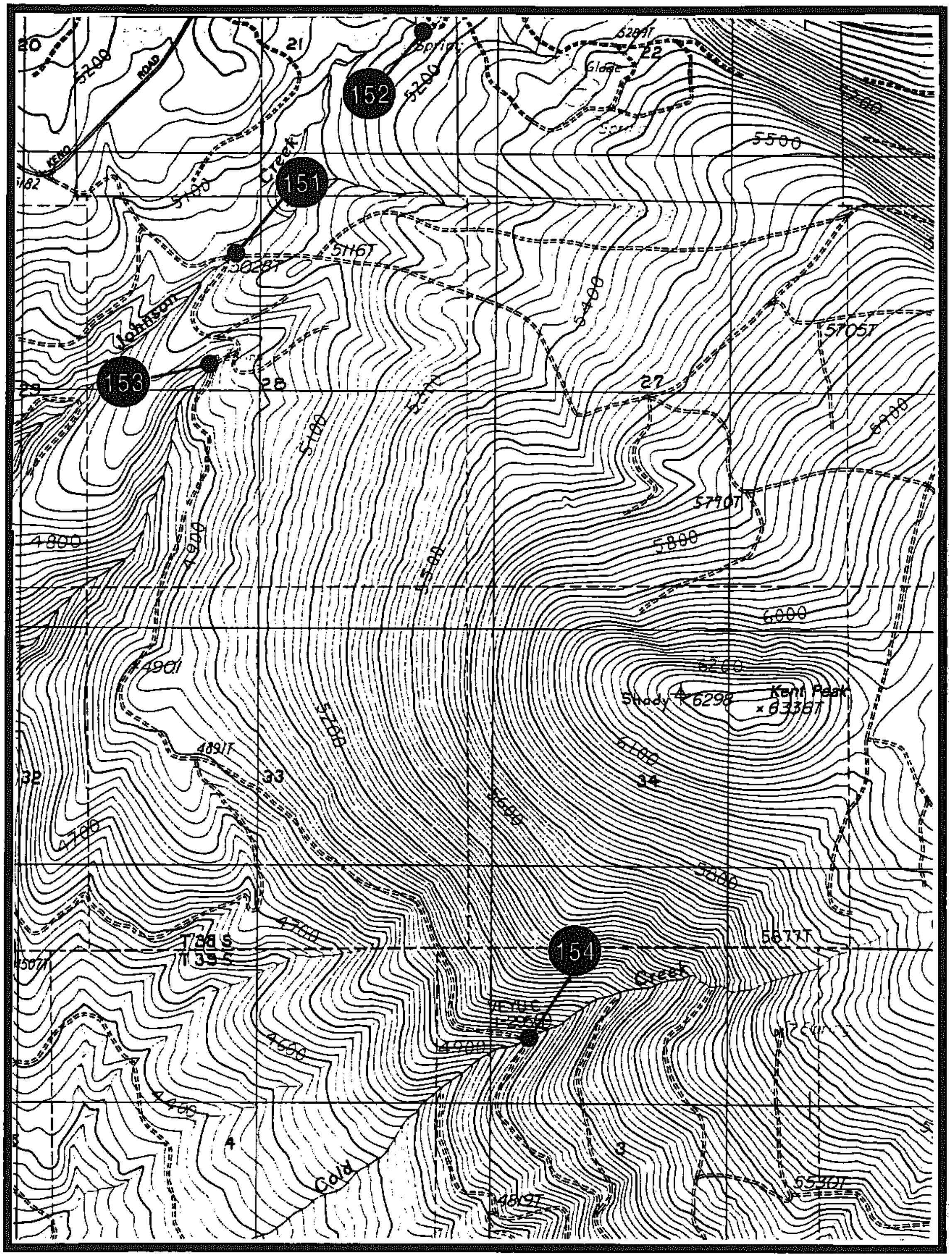
B91

43 121 15 √



SUGARPINE MTN. NW QUADRANGLE, KLAMATH CO., OR
SITES 175, 176

42 12222 √

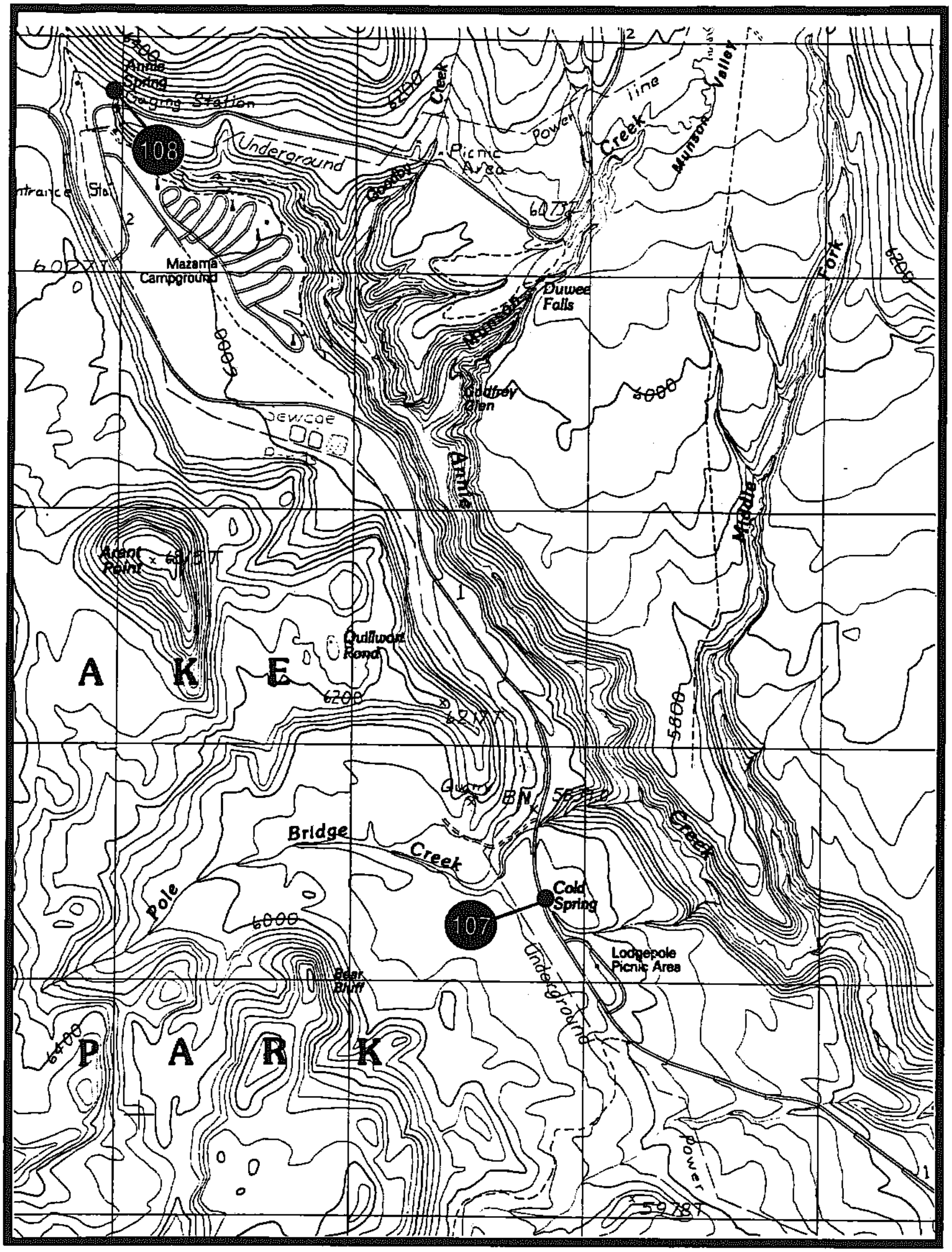


SURVEYOR MOUNTAIN QUADRANGLE, KLAMATH CO., OR
SITES 151, 152, 153, 154

153 = Keene .001

151, 152, 154 = ∅

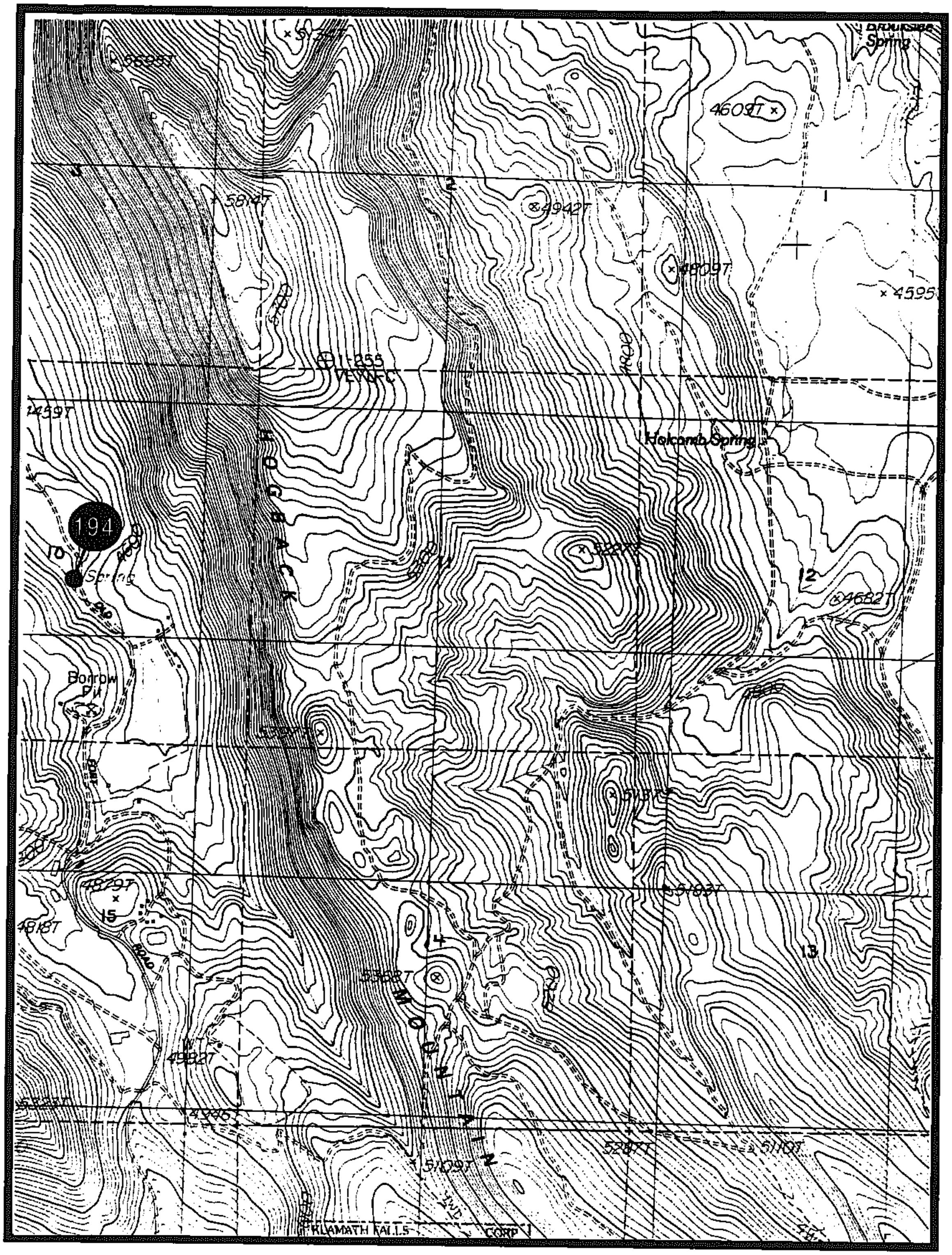
42 122 72



UNION PEAK QUADRANGLE, KLAMATH CO., OR
SITES 107, 108 = ∅

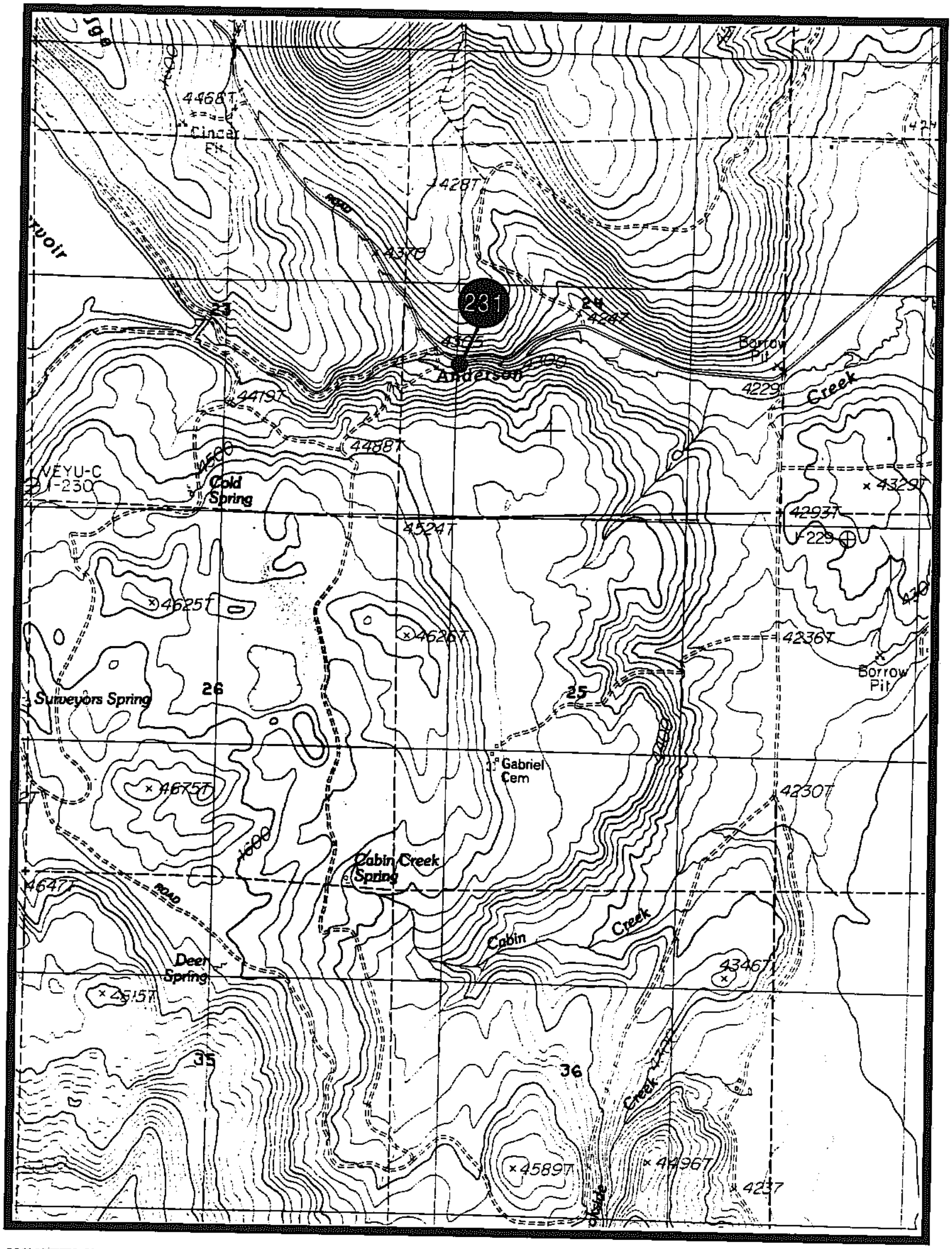
B94

42 12136



WHITELINE RESERVOIR QUADRANGLE, KLAMATH CO., OR
SITE 194 = Ø

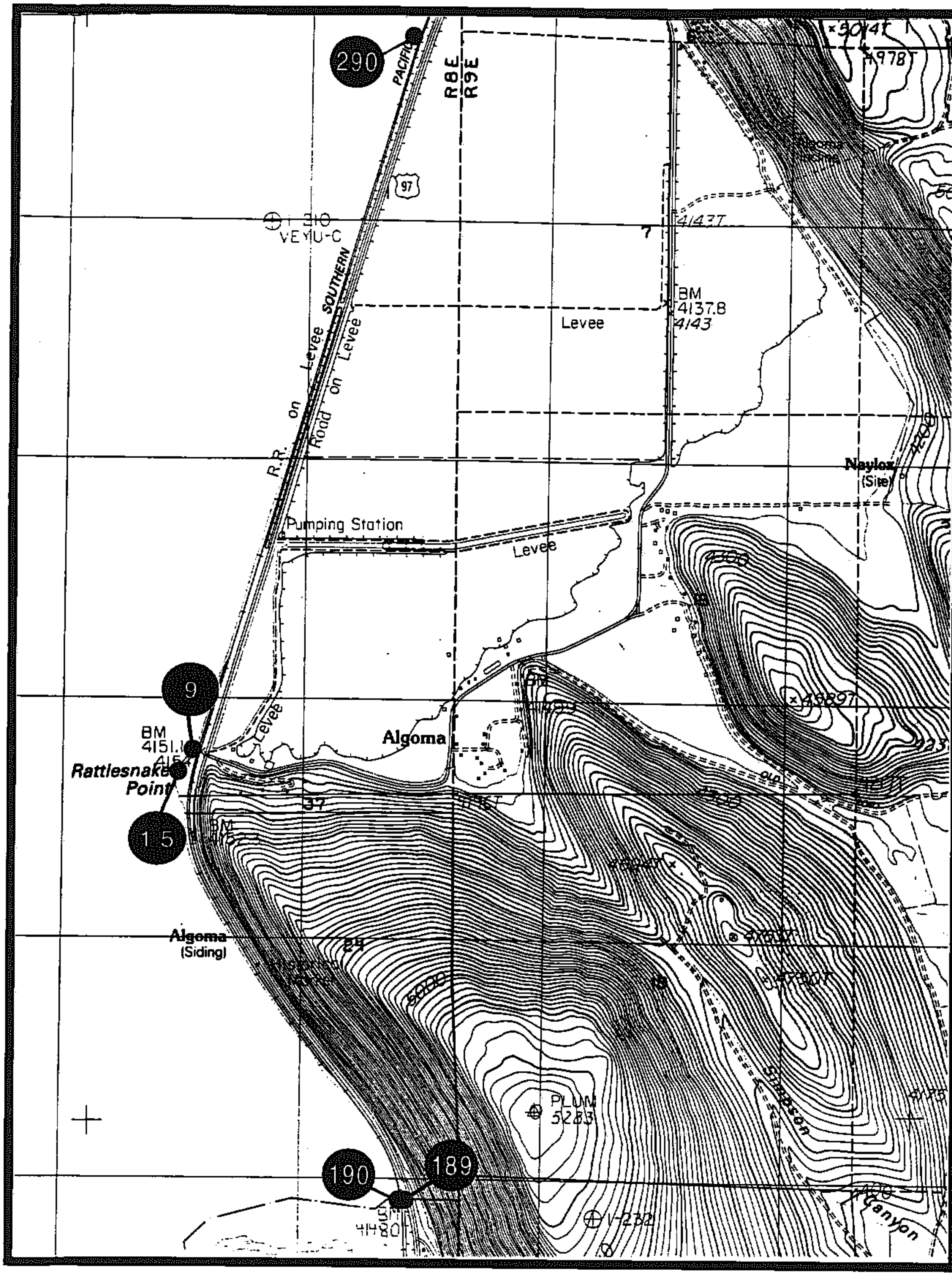
B95



WHITELINE RESERVOIR QUADRANGLE, KLAMATH CO., OR
SITE 231 = φ

B96

42 121 37 √



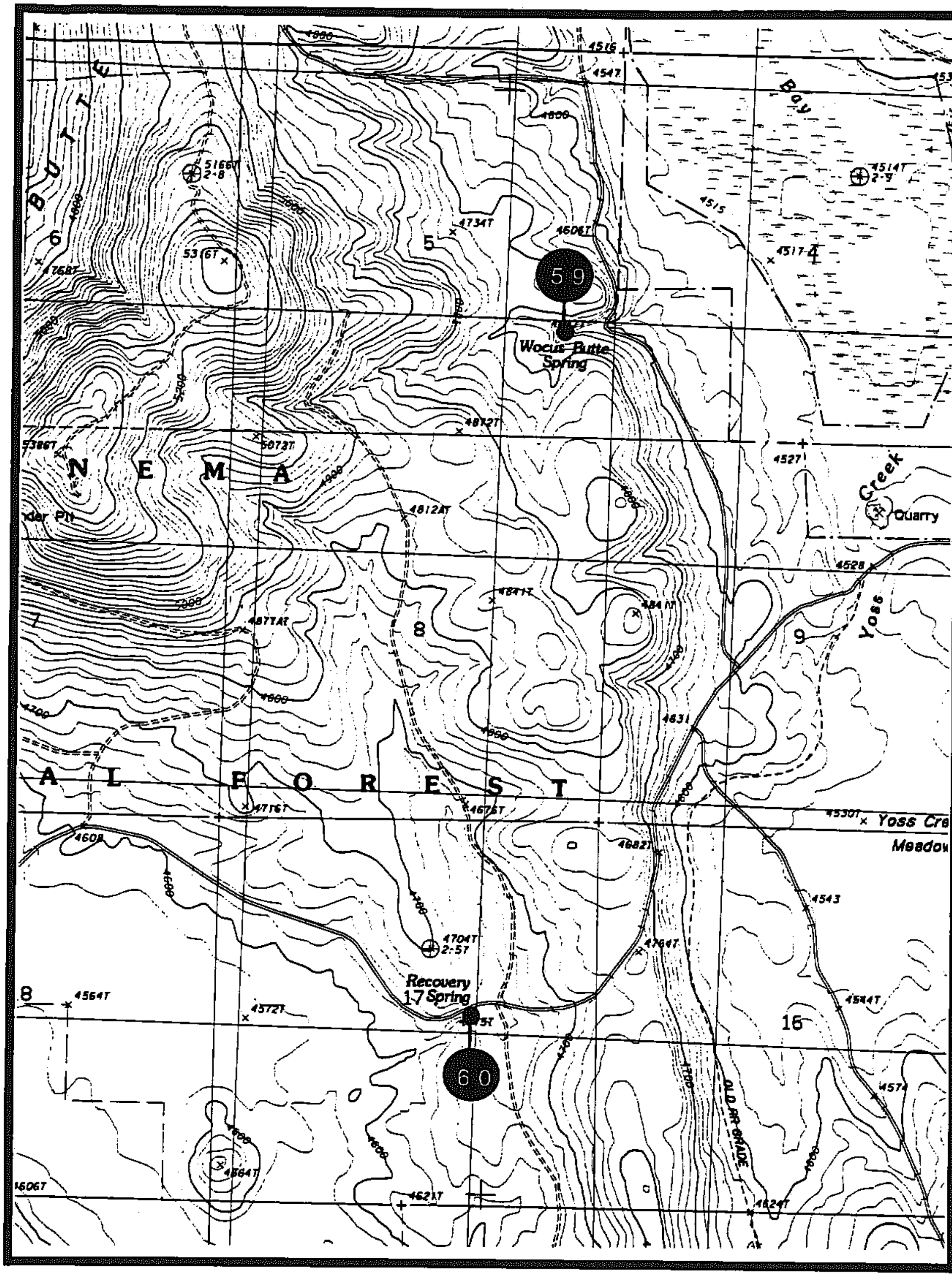
WOCUS QUADRANGLE, KLAMATH CO., OR
SITES 9, 15, 189, 190, 290

189, 190, 290 = Ø

9 = ? → 15 = Klamath .002
Pyr arc .001
Klamath lake .001
psi ult .007
Var eff dal .002
Lyo sp nov .001 → dotnum 1

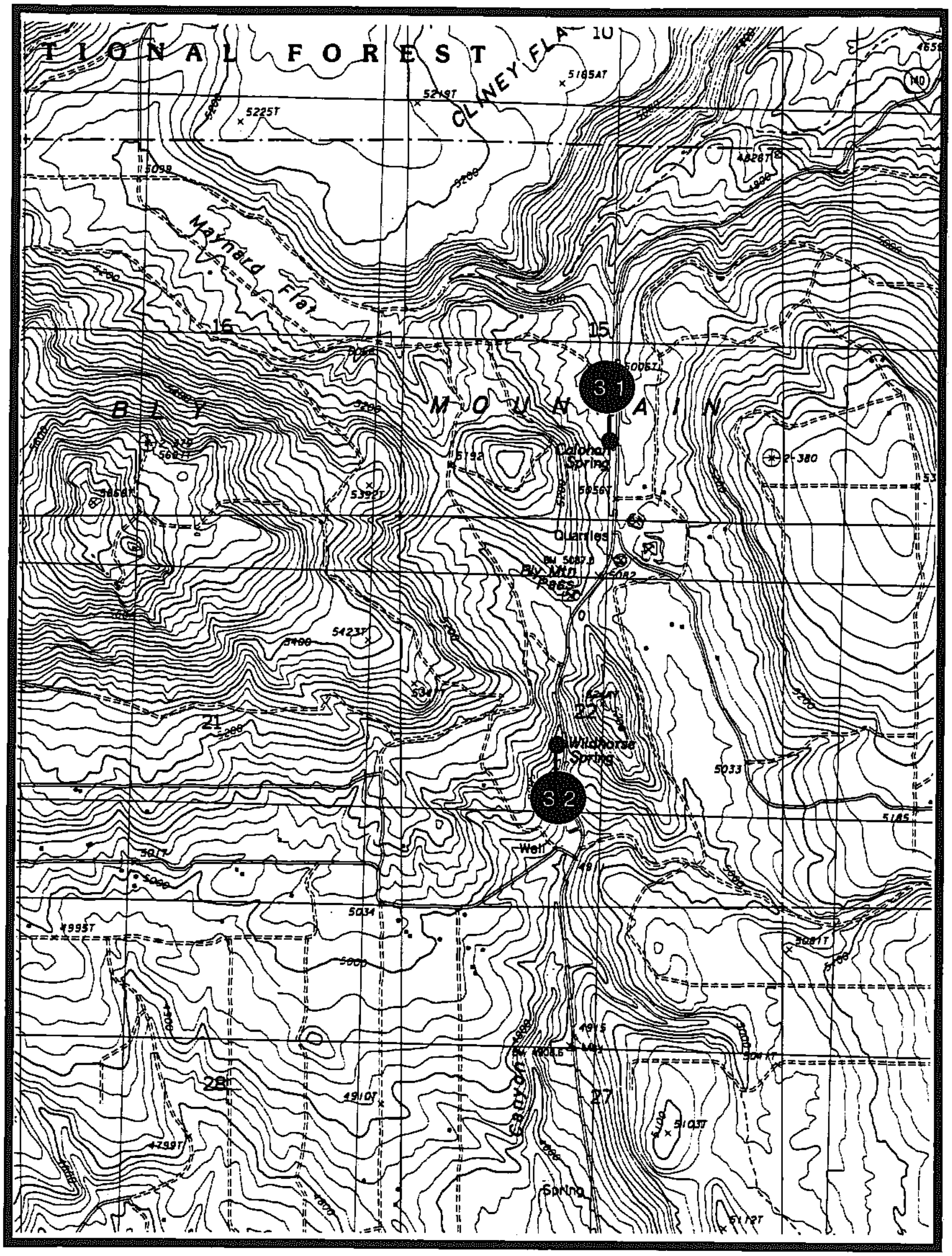
B97

4212176 √



WOCUS BAY QUADRANGLE, KLAMATH CO., OR
SITES 59, 60 = ∅

4212134 (



YONNA QUADRANGLE, KLAMATH CO., OR
SITES 31, 32 = ∅

APPENDIX C. KEYS TO SOME SENSITIVE UKL SPECIES.

The following keys should aid in field identification of UKL and some other currently recognized ROD Survey and Manage and Riparian Reserve species (ROD, 1994; J2, 1994), many of the UKL species considered Sensitive herein, and some similar and/or co-occurring forms. It does not cover all species mentioned in this work, let alone all known to occur in the Northwestern US. Two basic keys: one each for terrestrial forms, including both shelled taxa and slugs and semislugs, and for freshwater taxa, are included in Frest & Johannes (1998, in press); only the freshwater key is reproduced here. Termination points are for specific taxon entries in the **SENSITIVE SPECIES** discussions and, sometimes, for more common taxa likely to be encountered and confused with Sensitive taxa. To allow for coverage of Eastside Sensitive taxa and update of the Northern Spotted Owl lists, sets of keys for certain groups of species closely related to ROD forms; occurring in the same or nearby geographic areas; including several Sensitive forms; and/or readily capable of being confounded with them are provided after each basic key. Termination points with capital letters refer to these keys. It is wise to use both the species entry (in **SENSITIVE SPECIES**) and the secondary keys to minimize confusion. As always, consultation with a specialist may be necessary or prudent to permit secure identification.

Portions of certain of these keys have been adapted or modified from Frest & Johannes (1996a), whom we thank for permission to use this material.

A. AQUATIC SPECIES

A. Basic Key

Note that some of these characters are discernible only from live, properly relaxed and preserved specimens. This key has been based on shell characters to the maximum extent possible; but actual family and generic discriminants are based quite properly on anatomical characters. As with the preceding keys, terminations in taxon names refer to species in the **SPECIES DISCUSSIONS** or related, non-sensitive taxa, while capital letters relate to following secondary keys. The situation here is comparable to that noted previously with terrestrial taxa, in that the total number of species, including undescribed and yet to be discovered forms, and scarcity of morphological information for some precluded construction of a completely comprehensive key. Where possible, reference is made to figures in Burch (1989) to illustrate particularly important or basic morphological features. See **GLOSSARY** also.

This basic key was originally intended to cover mostly ROD species. Expansion here has made it necessary to include other taxa. In some cases, more detailed keys to particular genera, subfamilies, or families follow the basic key, especially when such groupings include several Sensitive species. In all such cases, reference is made to the detailed key at the highest taxonomic level practical in the basic key.

1 Shell with horny operculum 2
Shell lacking operculum 14

2 Operculum round, multispiral; nucleus central; shell thin, small (to 5 mm), usually depressed, semitransparent; single bipectinate gill to left and single pallial tentacle to right of mantle cavity .... Family Valvatidae (no ROD species)
Operculum oval; generally paucispiral, excentric; gill monopectinate; pallial tentacle absent; shell generally comparatively thick (opaque) 3

3 Adult shell medium-large size (over 1.5 cm); generally elongate; males lack verge .... Family Pleuroceridae: *Juga*: 4: see also key G
Adult shell small (generally under 1.5 cm height); males with verge 8

4 Juvenile smooth .... Subgenus *Oreobasis*: 5
Juvenile with concentric ridges .... Subgenus *Calibasis*: 7

5 Adult large, to 3.5 cm; strongly elongate conic; nacre white, shell with several yellow and brown bands .... *Juga (Oreobasis)* n. sp. 2
Adult small-large, to 3 cm length; nacre purple-brown; shell banded or bandless 6

6 Adult large, to 3 cm length; nacre light purplish-white; shell with 1 or 2 bands .... *Juga (Oreobasis) orickensis* (Henderson, 1935)
Adult smaller, to 2 cm length; nacre rich purple; shell bandless or with inconspicuous shoulder band .... *Juga (Oreobasis)* n. sp. 3

7 Adult cinnamon red-reddish black; spire tall, sides somewhat flattened .... *Juga (Calibasis) acutifilosa* (Stearns, 1890)
Adult greenish to brownish yellow; spire stout; whorls strongly convex .... *Juga (Calibasis) occata* (Hinds, 1844)

8 Habit generally amphibious or terrestrial; head-foot subdivided on each side by a longitudinal groove .... Family Pomatiopsidae (no ROD species)
Habit generally aquatic; head-foot not subdivided by a longitudinal groove .... Family Hydrobiidae 9

9 Males with single-ducted verge (penis) 10
Males with two- ducted verge (penis and accessory lobe) .... Subfamily Amnicolinae: 13: see also key H

10 Nuclear whorl of shell relatively large (0.38-0.48 mm in diameter); operculum paucispiral, nucleus excentric; verge lobes relatively stout ....Genus *Amnicola* (no ROD species)
Nuclear whorl of shell relatively small (0.29-0.36 mm in diameter); operculum multispiral; nucleus subcentral; verge lobes relatively slender .... Genus *Lyogyrus*: 11: see also more detailed key H

11 Shell tall, 6 whorls; body light with mask of pigment around eyes and proximal end of snout .... *Lyogyrus* n. sp. 2
Shell depressed, 3-4 whorls; body light-dark, but no mask 12

12 Shell very small (height under 2 mm); yellow, transparent; body and visceral coil essentially pigmentless .... *Lyogyrus* n. sp. 3
Shell larger (to 2.5 mm height); clear-whitish, transparent; body light even gray; visceral coil black .... *Lyogyrus* n. sp. 1

13 Verge with single duct; generally with accessory lobe and glandular patches .... Subfamily Nymphophylinae: Genus *Pyrgulopsis* (1 ROD species; not readily keyable: see *Pyrgulopsis* n. sp. 20)
Verge simple, with single duct; no accessory lobe or glandular patches ....Subfamily Lithoglyphinae: Genus *Fluminicola* (see Upper Sacramento, middle Klamath, and Upper Klamath keys [B-D)

14 Shell limpet-shaped 15
Shell coiled 17

15 Apex on midline; no gills; generally over 1 cm length ...... Family Lancidae : see key F
Apex not on midline; generally less than 1 cm length 16

16 Animal and shell dextral (coiled to right) ....
.... Superfamily Acroloxoidea Family Acroloxidae (no ROD species)
Animal and shell sinistral (coiled to left) ....
.... Superfamily Ancyloidea (*pars.*) Family Ancylidae (no ROD species)

17 Animal and shell dextral (coiled to right) ....
.... Superfamily Lymnaeoidea (*pars.*) Family Lymnaeidae (*pars.*) (no ROD species) 23
Animal and shell sinistral (coiled to left) ....
.... Superfamily Ancyloidea (*pars.*) (no ROD species) 18

18 Shell with raised (usually rather short) spire; blood nearly colorless; no pseudobranch (false gill); mantle digitate or lobed .... Family Physidae (no ROD species)
Shell with flat (sunken) spire; blood red; pseudobranch near pneumostome or anus; mantle margin simple .... Family Planorbidae 19

19 Shell small, under 7 mm diameter, flat or depressed spire; much compressed ....
.... Genera *Menetus*, *Gyraulus*, and *Promenetus* (no ROD species)
Shell larger, often over 1 cm diameter 20

20 Shell with few, rapidly increasing whorls; body whorl disproportionately large; perforate to not umbilicate .... Genus *Vorticifex*: see key E
Shell with more than a few (often many) whorls, not particularly rapidly increasing; body whorl not disproportionately large; umbilicus generally large 21

21 Left side of shell spire strongly inverted; with more or less deep conical depression; spire side of body whorl with or without strong keel .... Genus *Helisoma*: 22
Left side of shell spire not strongly inverted; with depression either shallow, absent, or raised above body whorl (exverted); spire side of body rounded or angular ....
.... Genus *Planorbella* (no ROD species)

22 Spire side of body whorl without strong keel(s) ....
.... Subgenus *Helisoma*, *s.s.* (no ROD species)
Spire side of body whorl with one or more strong keels ....
.... Subgenus *Carinifex*: *Carinifex newberryi newberryi* (Lea, 1858)

23 Adult shell with large, globose body whorl; no spiral striation ....
.... *Radix auricularia* (not a ROD taxon)
Adult shell with narrow to globose body whorl; if globose, sculptured with microscopic spiral striations 24

24 Shell succiniform (thin and fragile with a large, oval aperture and body whorl); small spire; surface with microscopic raised, spiral periostracal threads ....
.... *Pseudosuccinea columella* (not a ROD taxon)
Shell not succiniform, aperture may or may not be large and oval, but if so, shell not thin and fragile; and not sculptured with microscopic raised, spiral periostracal threads 25

25 Shell large, adult more than 35 mm in length 26
Shell smaller, adult less than 35 mm in length 27

26 Shell with a relatively narrow body whorl 27
Shell with a wider, expanded, elongately oval to globose body whorl, sharp spire .... Genus *Lymnaea* (no ROD species

27 Adult shell medium-large, generally more than 13 mm (occasionally roughly 13 mm) in length; surface sculptured with microscopic spiral striations; columella usually with a well-developed twist or plait .... Genus *Stagnicola* (*pars.*) (no ROD species)
Adult shell relatively small, generally less than 13 mm [although occasionally up to 15-16 mm) in length; spiral sculpture usually absent, very weak when present; columella generally without a twist or plait .... Genus *Fossaria* (no ROD species)

B. Key to the Upper Klamath Lake drainage *Fluminicola* species

About 11 species of *Fluminicola* (*s.l.*) are currently known from the Upper Klamath Lake drainage. All appear to be endemic to the Klamath Basin and undescribed. A few others are likely to be discovered. For information on Upper Klamath Lake drainage species to date, see Frest & Johannes (1995c; 1996b). These taxa are best discriminated by anatomic criteria; but shell characters can be used also. For example of more complete description of *Fluminicola* (*s.l.*), see Hershler & Frest (1996). Western US material thought possibly belonging to either the Pomatiopsidae or Lithoglyphinae, with the possible exception of the taxa covered in Hershler & Frest (1996), should be relaxed and preserved and examined by specialists. This key does not cover all known and likely species; but should eliminate the non-ROD taxa and allow tentative identification of middle Klamath-Upper Klamath Lake drainage ROD taxa. **Identification of extralimital taxa, even in immediately adjacent drainages, should not be attempted using this key; and addition of other taxa will require its modification** (for example, see Upper Sacramento drainage key below). Because various number schemes have been applied to the undescribed taxa, only those used for the ROD report are used here [n. sp. 1-3]; the remaining taxa are numbered as in Frest & Johannes (1996b). For Middle Klamath (Jenny Creek-Fall Creek) taxa, see key C.

1	Shell comparatively large, over 1 cm in height	2
	Shell comparatively small, generally under 7 mm in height	5
2	Body light in color; tentacles and eye patches dark	3
	Body dark in color; tentacles and eye patches dark	4
3	Penis sickle-shaped; shell tall subglobose; whorls convex; yellow-green; closed .... umbilicus	*Fluminicola* n. sp. 1
	Penis alate from midpoint distally; shell globose, whorls evenly convex; closed umbilicus	*Fluminicola* n. sp. 8 Frest & Johannes, 1996b
4	Penis sickle-shaped, pigmented basally .	*Fluminicola* n. sp. 27 Frest & Johannes, 1996b
	Penis alate basally on left side	*Fluminicola* n. sp. 28 Frest & Johannes, 1996b
5	Shell tall-medium conical, to 7 mm height	6
	Shell low conical to globose	7

6 Shell tall conical; to 5 mm height; spire complete; penis white, alate .... *Fluminicola* n. sp. 2

Shell medium conical, decollate; to 7 mm if complete; penis broad sickle-shape; subepithelial bar; light epithelial pigment to end; tip papillate ... *Fluminicola* n. sp. 42

7 Shell low conic 8

Shell subturbinate to globose 11

8 Shell low conic; < 2 mm height; gray body and tentacles; thin, sickle-shaped penis .... *Fluminicola* n. sp. 3

Shell low conic; > 2 mm height 9

9 Umbilicus closed; whorls convex; dark gray body and black tentacles; moderately large, sickle-shaped penis with basal folds; aperture rounded, barely reinforced .... *Fluminicola* n. sp. 7 Frest & Johannes, 1996b

Small open umbilicus 10

10 Shell smaller (*ca.* 2 mm height); blunt-topped; distinctly open umbilicus .... *Fluminicola* n. sp. 9 Frest & Johannes, 1996b

Shell large (to 3 mm height); taller; very small open umbilicus .... *Fluminicola* n. sp. 31 Frest & Johannes, 1996b

11 Gray body and tentacles; shell with evenly convex whorls; penis sickle-shaped, unpigmented .... *Fluminicola* n. sp. 29 Frest & Johannes, 1996b

Gray body and tentacles; shell with subangulate periphery; penis broadly alate, pigment spots and bars .... *Fluminicola* n. sp. 30 Frest & Johannes, 1996b

C. Key to Middle Klamath (Jenny Creek-Fall Creek) *Fluminicola* species

At present, about 7 taxa of this genus are known from the Jenny Creek-Fall Creek area. Note that further exploration may modify this number; and that some adjacent drainages (*e.g.*, Johnson Creek; Keene Creek) also have *Fluminicola*. Only one of these taxa is included here. Consultation with a specialist is very helpful in identifying taxa from this region; and soft part criteria are very important.

1 Adult shell under 1.5 mm in length; shell thick, subglobose; aperture heavily reinforced; last 1/4 whorl deflected .... *Fluminicola* n. sp. 6
Adult shell > 1.7 mm in length 2

2 Adult shell subconic 3
Adult shell neritiform; strongly reinforced apertural margin; few whorls; strong axial ridge .... *Fluminicola* n. sp. 4

3 Shell yellow in color; often with brown coating; last whorl and aperture disjunct; aperture reinforced all around, lunate; body pigment lacking .... *Fluminicola* n. sp. 9
Shell green or greenish-yellow 4

4 Shell greenish-yellow; subconic 5
Shell green 6

5 Aperture with thin margin all around; length 3 mm; whorls moderately convex .... *Fluminicola* n. sp. 7
Aperture with somewhat thickened margin all around; length 2 mm; whorls slightly flattened .... *Fluminicola* n. sp. 11

6 Shell normally coiled; aperture simple (lacking nodes or lamellae) 7
Last 1/2-1 whorl disjunct, deflected downward; aperture reinforced all around; single strong columellar node .... *Fluminicola* n. sp. 5

7 Shell low trochoid-subglobose, to 4 mm height; dark green; aperture slightly reinforced all around, more heavily along columella .... *Fluminicola* n. sp. 10
Shell low conic, to 3.5 mm height; apple green; aperture slightly reinforced all around .... *Fluminicola* n. sp. 8

D. Key to Extant Species of *Vorticifex*

Living species of *Vorticifex* (sometimes placed in the separate genus or subgenus *Parapholyx*) are mostly poorly studied, aside from some of those dealt with in Baker (1945). Their relationships to the numerous Late Cenozoic forms also need to be clarified. Anatomical discriminants in this group appear to be comparatively subtle. We have retained the current classification, mostly derived from Baker (1945), as the subspecific epithets are likely to be valid; however, certain of the subspecies are likely either to be recognized eventually as full species or to show closer relationships to taxa currently assigned to another species or undescribed.

This genus is a strongly atypical planorbid, being a stream-adapted, cold stenothermal mollusk most typical of cold oligotrophic flowing-water habitats of medium-large size. In some ways, its ecology is much closer to that of the aberrant limpet-shaped lymnaeid group Lancidae (with which they often occur) than to stereotypical Planorbidae.

1 Shell neritiform, thick; aperture thickened around whole periphery, so that aperture opening evidently constricted .... *neritoides* (Hemphill in Baker, 1945)
Shell thin; neritiform or with low spire; callus at columella and base only; aperture not constricted 2

2 Shell neritiform 3
Shell with short spire or almost neritiform 4

3 Shell large, to 2.5 cm diameter; very thin, cinnamon-colored; no varices or periostracal fringes .... *klamathensis klamathensis* (Baker, 1945)
Shell large, to 2.5 cm diameter; very thin, yellowish, with prominent regular periostracal fringes and underlying shallow varices .... *effusus dalli* (Baker, 1945)

4 Shell with definite spire 5
Shell with very low spire or nearly neritiform 6

5 Shell solid but not thick; to 2 cm diameter; juvenile whorls rounded; no varices .... *klamathensis sinitsini* (Baker, 1945)
Shell comparatively thin; less than 1 cm diameter; juvenile whorls strongly keeled; prominent varices, with or without small periostracal fringes .... n. sp. 1

6 Shell thin to somewhat solid; diameter to 3 cm; with several low diagonal ribs on final whorl .... *effusus diagonalis* (Henderson, 1929)
Shell typically somewhat solid; diameter generally 1 cm or less; surface nearly smooth, with very fine growth lines; occasional scattered low periostracal fringes; no varices .... *effusus effusus* (Lea, 1856)

E. Key to Extant Species of Lancidae

The endemic western North American lymnaeid family is easily distinguished from other freshwater limpets by their larger size and circumferential muscle scar (unlike bundled muscles of Ferrissia, *e.g.*). Only well-known taxa are covered below. There are some indications of additional undescribed taxa and several fossil representatives whose relationships to these forms are uncertain as yet.

1	Muscle scar incomplete	2
	Muscle scar complete	3
2	Apex anterior-subcentral; large (length > 1 cm); height much less than width or length .... *Fisherola nuttalli* (Haldeman, 1843)	
	Apex posterior-subcentral; small (length < 7 mm); height equal or greater than width, subequal to length .... *Lanx* n. sp. (Banbury Springs lanx)	
3	Shell low, scale-like; thin; height much less than width .... *Lanx klamathensis* Hannibal, 1912	
	Shell higher	4
4	Shell comparatively low; commonly streaked and dotted with white as well as red pigment .... *Lanx patelloides* (Lea, 1856)	
	Shell comparatively high; red pigment only or rare white streaks	5
5	Shell comparatively high; height more than 1/2 width .... *Lanx alta* (Tryon, 1865)	
	Shell comparatively low, ca. 1/2 width .... *Lanx subrotundata* (Tryon, 1865)	

F. Key to some Western US Species of Amnicolinae

With the exception of *Lyogyrus greggi*, western US Amnicolinae (regarded as a separate family by Davis *et al.*, 1985: Davis, 1996; but see Ponder & Warén, 1988; Kabat & Hershler, 1993) were virtually unknown until the last seven years (see, *e.g.*, Hershler & Thompson, 1988; Hershler & Holsinger, 1990). They are still typically rare and scattered, especially as compared to the nymphophylinid *Pyrgulopsis* and the characteristic western lithoglyphinids *Fluminicola* and *Pristinicola*. Most are as yet undescribed. Taxonomy of this subfamily is changing rapidly (see, *e.g.*, Thompson & Hershler, 1991; Hershler, in press), so that the recent literature should be examined carefully and a specialist should be consulted before definite assignment of problematic Hydrobiidae possibly belonging to this group. Hershler (in press) describes a new genus for *L. greggi* and *Lyogyrus* n. sp. 10, to which many of the western US species probably should be assigned. See also basic key and taxon entries in **SENSITIVE SPECIES** discussions.

1 Nuclear whorl of shell relatively large (0.38-0.48 mm in diameter); operculum paucispiral, nucleus clearly excentric; penial lobe and filament relatively stout; lobe originates about half way up filament .... Genus *Amnicola* (no ROD species: only western species *Amnicola* n. sp. 1)
Nuclear whorl of shell relatively small (0.29-0.36 mm in diameter); operculum paucispiral; nucleus subcentral; penial lobe and filament relatively slender; lobe originates near base of filament .... Genus "*Lyogyrus*": 2

2 Shell very tall conic, 6-8 whorls; operculum almost multispiral 3
Shell depressed-moderately tall conic, 3-6 whorls; operculum definitely paucispiral 4

3 Body light with mask of pigment around eyes, proximal end of snout, body sides; to 8 whorls, 4 mm height, unpigmented penial lobes .... *Lyogyrus* n. sp. 2
Body light, no mask, to 6 whorls, 2.5 mm height, narrowly conic; penial filament pigmented .... *Lyogyrus* n. sp. 6

4 Shell off-white, light tan, or orange 5
Shell yellow 10

5 Shell orange; to 1.5 mm height; 3 whorls, low-medium conic, black visceral coil, gray head, tentacles, and verge lobes .... *Lyogyrus* n. sp. 7
Shell off-white or light tan 6

6 Spire strongly depressed to nearly flat; visceral coil black; head and tentacles light gray (a few melanin granules) verge lobes unpigmented; to 1.5 mm height; 3 1/2-4 whorls .... *Lyogyrus* n. sp. 9
Spire with taller spire; dome-shaped or low to medium conic 7

7 Spire low conical, to 1.5 mm height; 3 1/2 whorls; visceral coil black; light gray head and tentacles; unpigmented verge lobes .... *Lyogyrus* n. sp. 1
Spire medium conical or dome-shaped 8

8 Spire with early whorls dome-shaped; *ca.* 3.5 whorls; dark visceral coil and tentacles; body medium gray .... *Lyogyrus* n. sp. 10
Spire medium or moderately tall conical 9

9 Spire moderately tall conical, to 2.5 mm height, 4-5 whorls; black visceral coil; dark gray head, tentacles, and verge lobes .... *Lyogyrus greggi* (Pilsbry, 1935)
Spire medium conical, to 1.5 mm height, 4 whorls; black visceral coil; medium gray head and tentacles, verge lobes .... *Lyogyrus* n. sp. 5

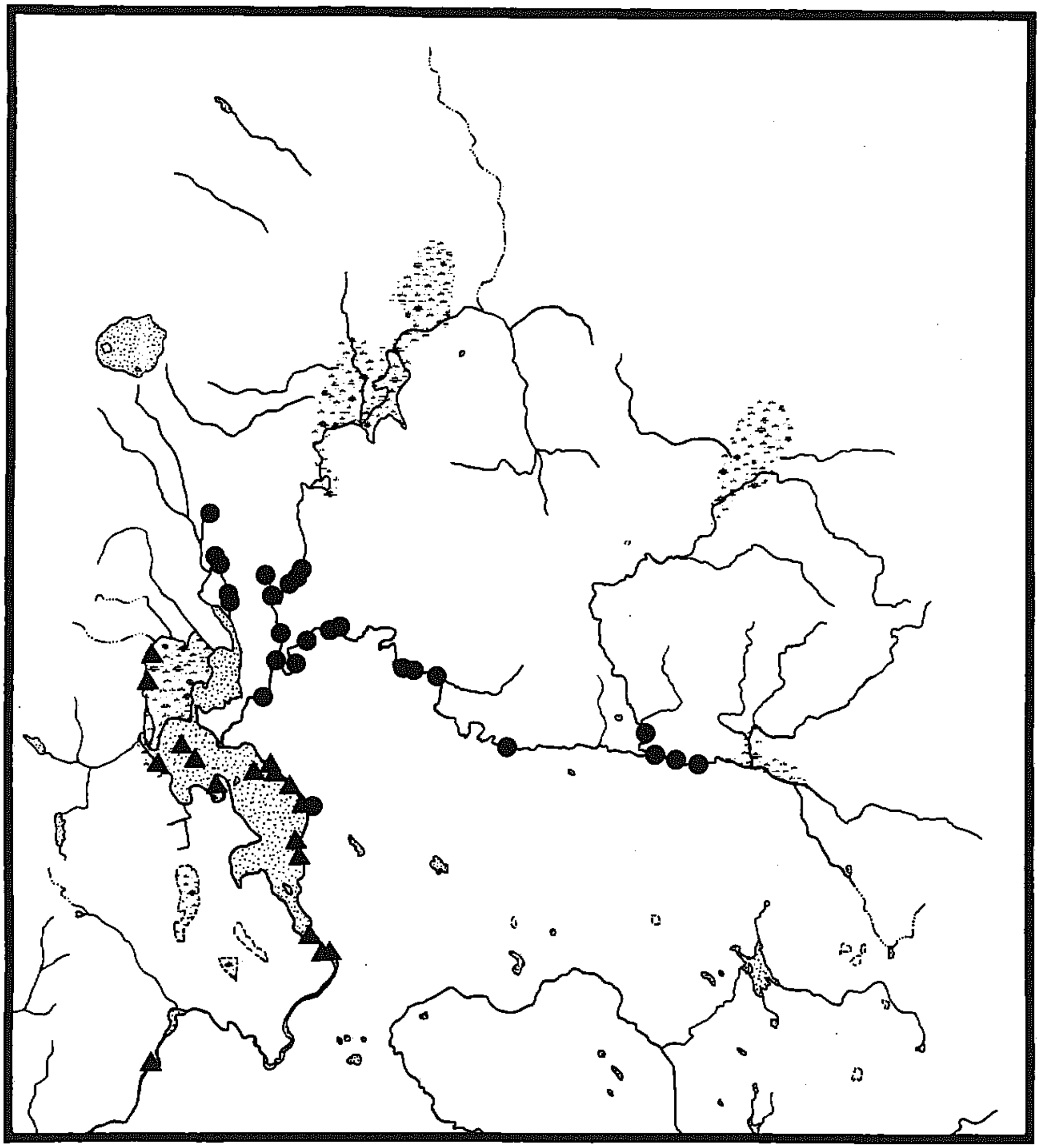
10 Shell nodose, small (height 1.2 mm), medium conical, 3 whorls; transparent; body and visceral coil essentially pigmentless; shell periphery angulate .... *Lyogyrus* n. sp. 4
Shell almost smooth 11

11 Shell about 1.2 mm in height, low conical, 3 whorls, transparent; light yellow; body and visceral coil almost pigmentless; verge lobes unpigmented .... *Lyogyrus* n. sp. 3
Shell very small, about 1 mm height, depressed conical, 3 whorls, transparent; canary yellow; body and visceral coil almost pigmentless; verge lobes unpigmented .... *Lyogyrus* n. sp. 8

APPENDIX D.
SPECIES DISTRIBUTION MAPS FOR THE UPPER KLAMATH LAKE DRAINAGE.

Maps of the Upper Klamath Lake drainage in Oregon, showing distribution of individual taxa. For scale, names of major features, site locations, and inset showing location of survey area, see **Figure 1**; for precise sites, see Tables 3-4 and **APPENDIX A**; for detailed site maps, see **APPENDIX B.** Sites with particular mollusk taxon shown as black symbols; identity as indicated below map. Partial distribution of some taxa also shown on detailed figures (**Figures 3-10; 12-23**). Symbols often represent more than one site.

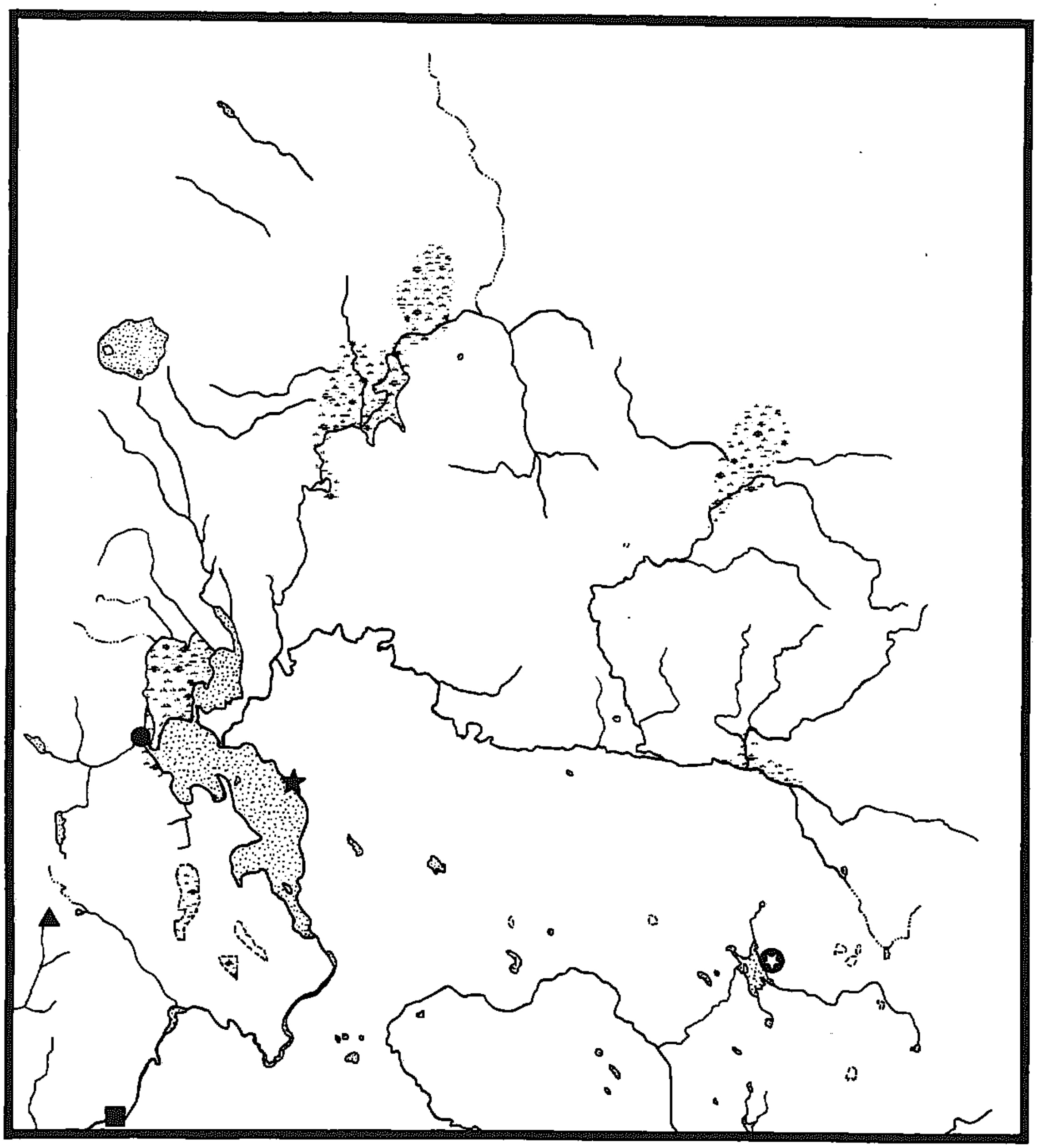
Left border of map is the Jackson-Klamath Co. border. Larger permanent water bodies indicated by dot shading; larger marshes also shown by standard pattern.



▲ = *Fluminicola* n. sp. 1

● = *Fluminicola* n. sp. 27

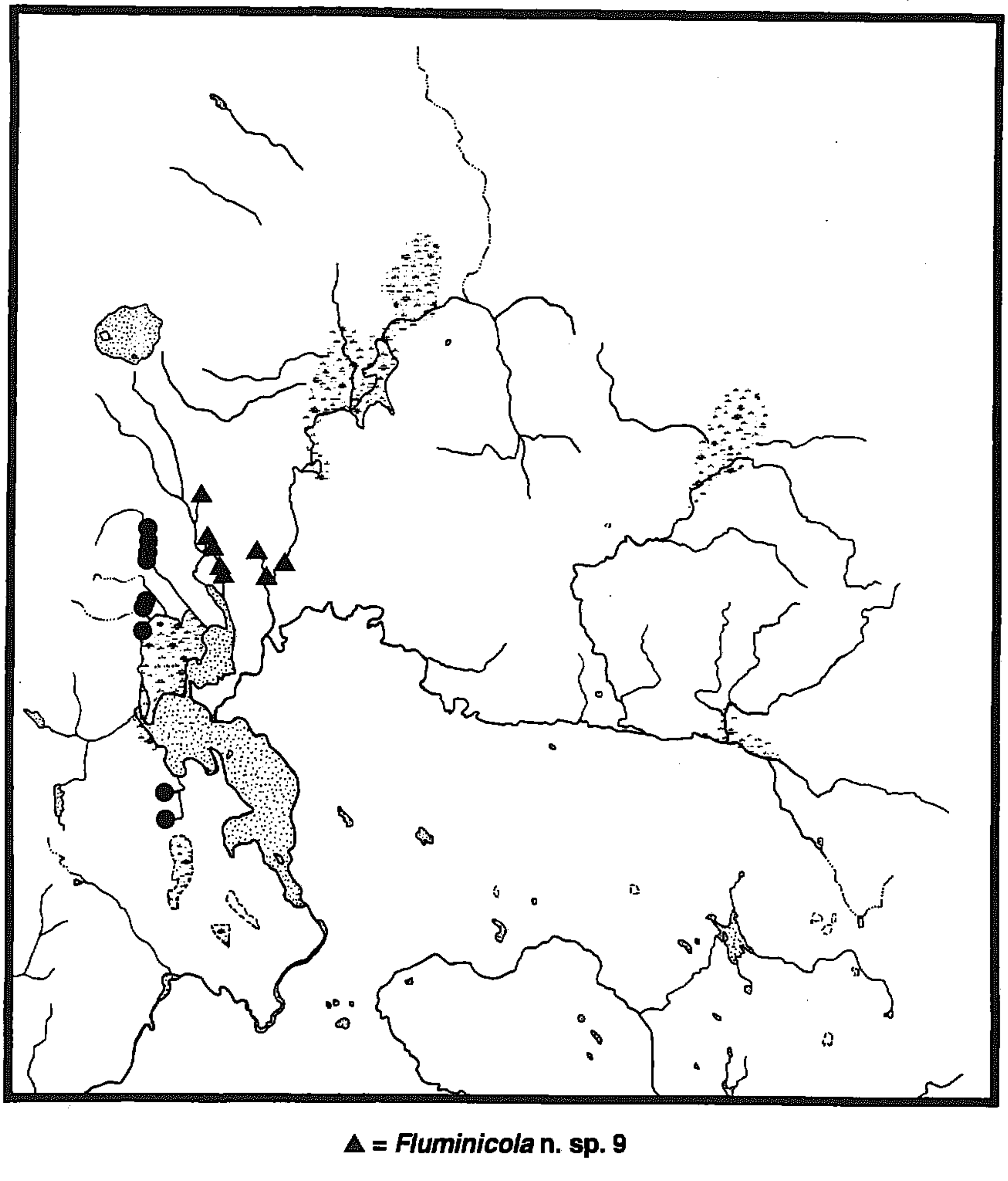
D 2



▲ = *Fluminicola* n. sp. 16 ★ = *Fluminicola* n. sp. 29 ✪ = *Fluminicola* n. sp. 30

● = *Fluminicola* n. sp. 2 ■ = *Fluminicola* n. sp. 3

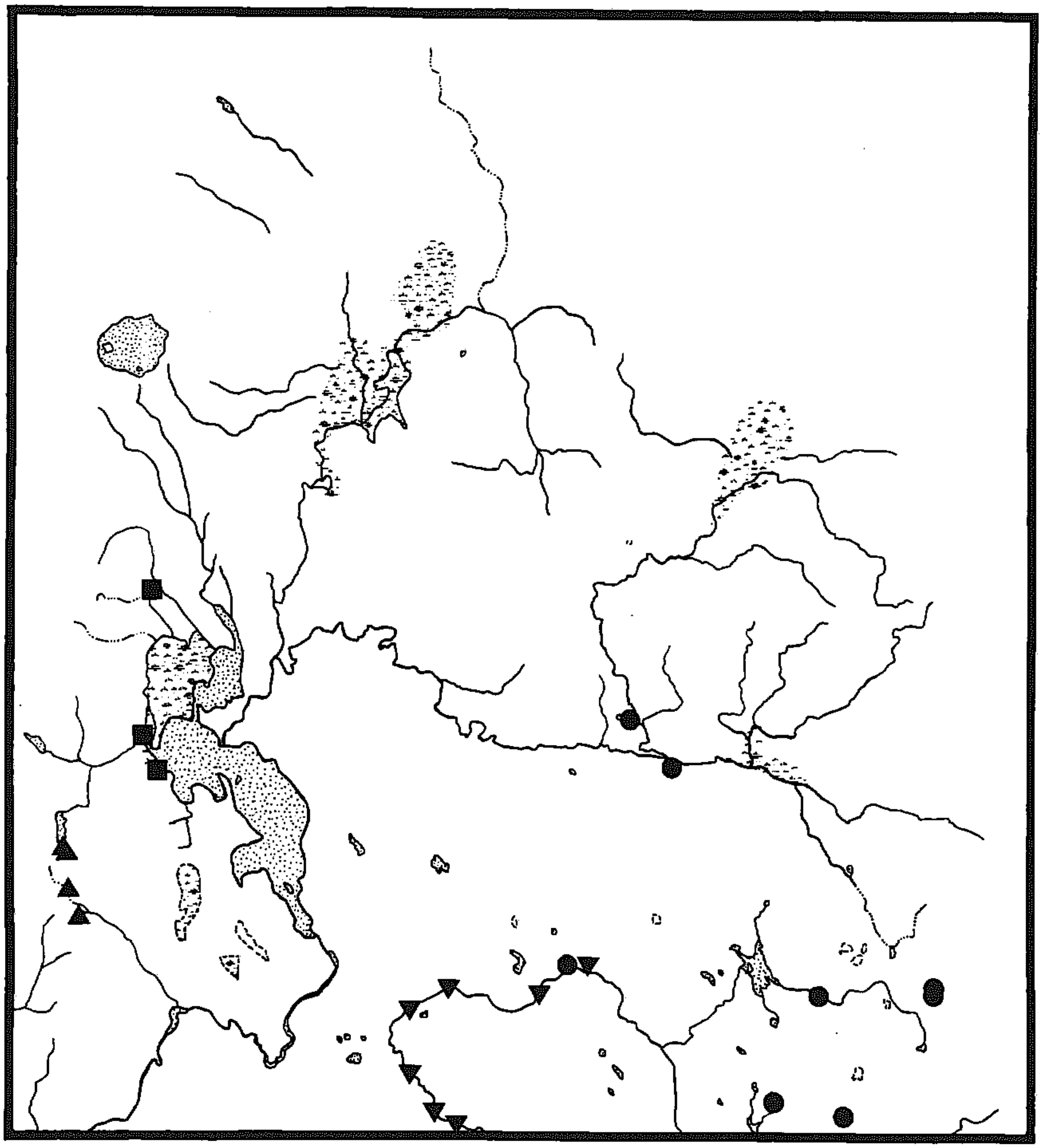
D 3



▲ = *Fluminicola* n. sp. 9

● = *Fluminicola* n. sp. 7

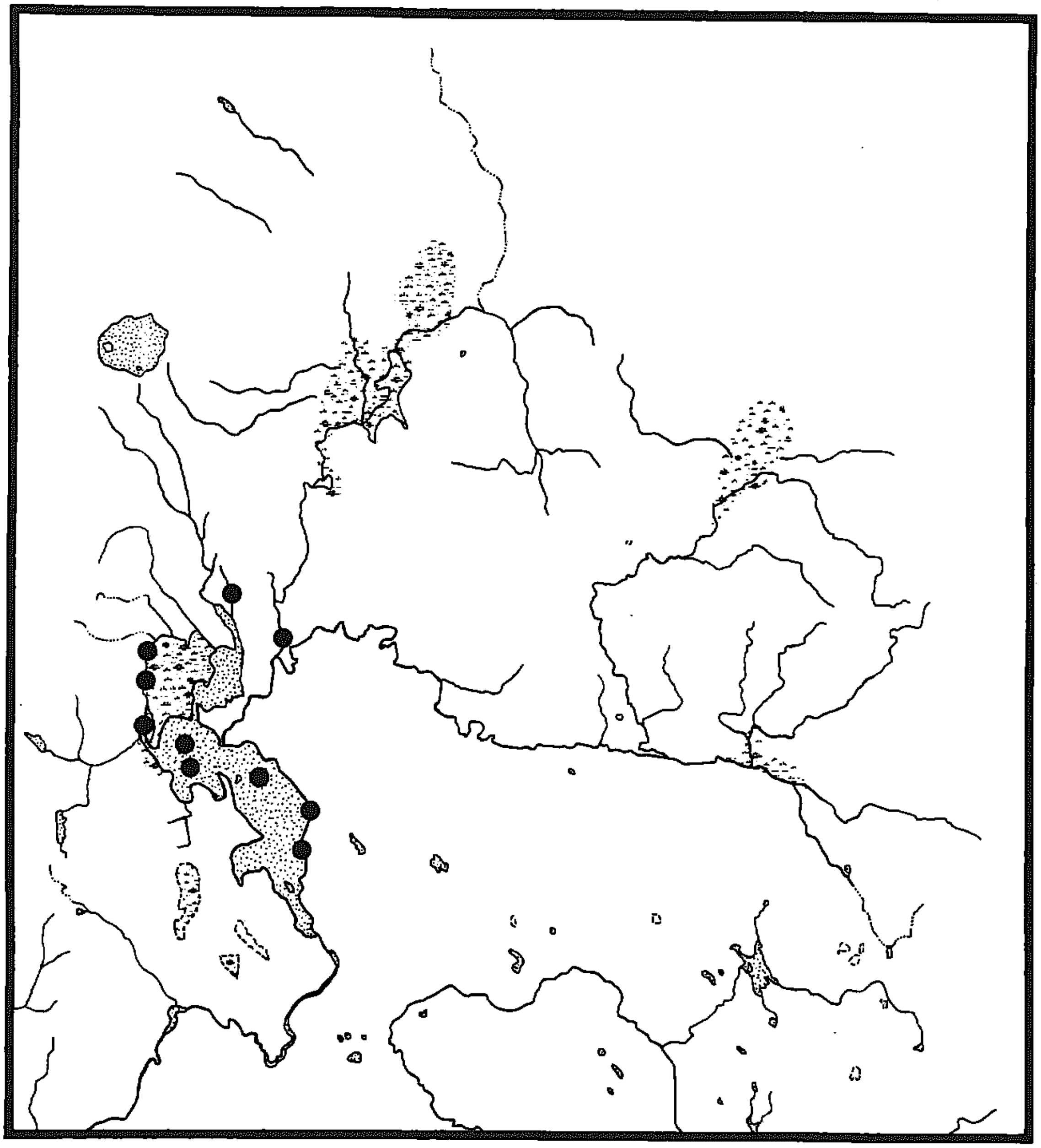
D 4



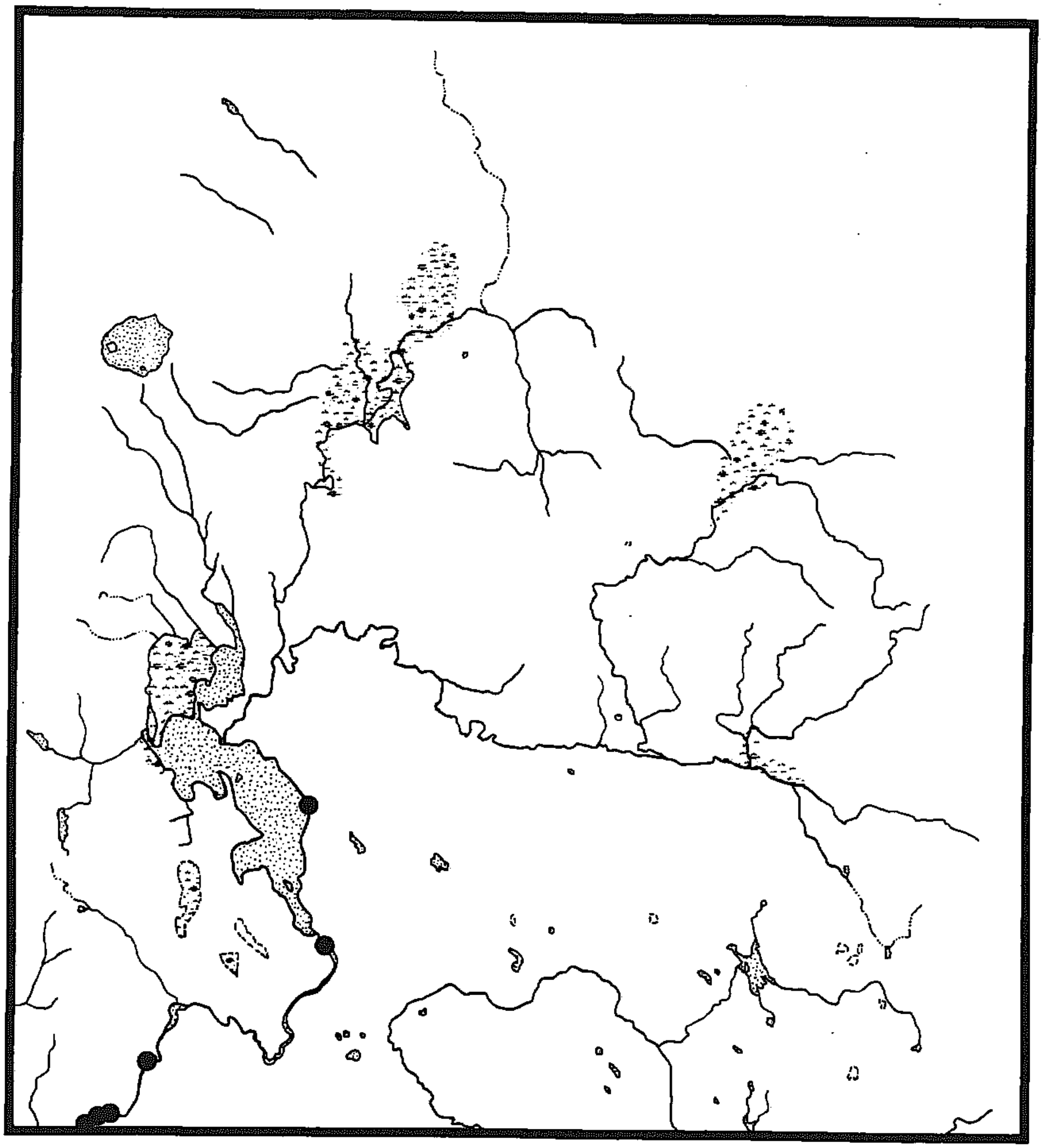
▲ = *Fluminicola* n. sp. 31 ▼ = *Fluminicola* n. sp. 8

● = *Fluminicola* n. sp. 42 ■ = *Fluminicola* n. sp. 28

D 5

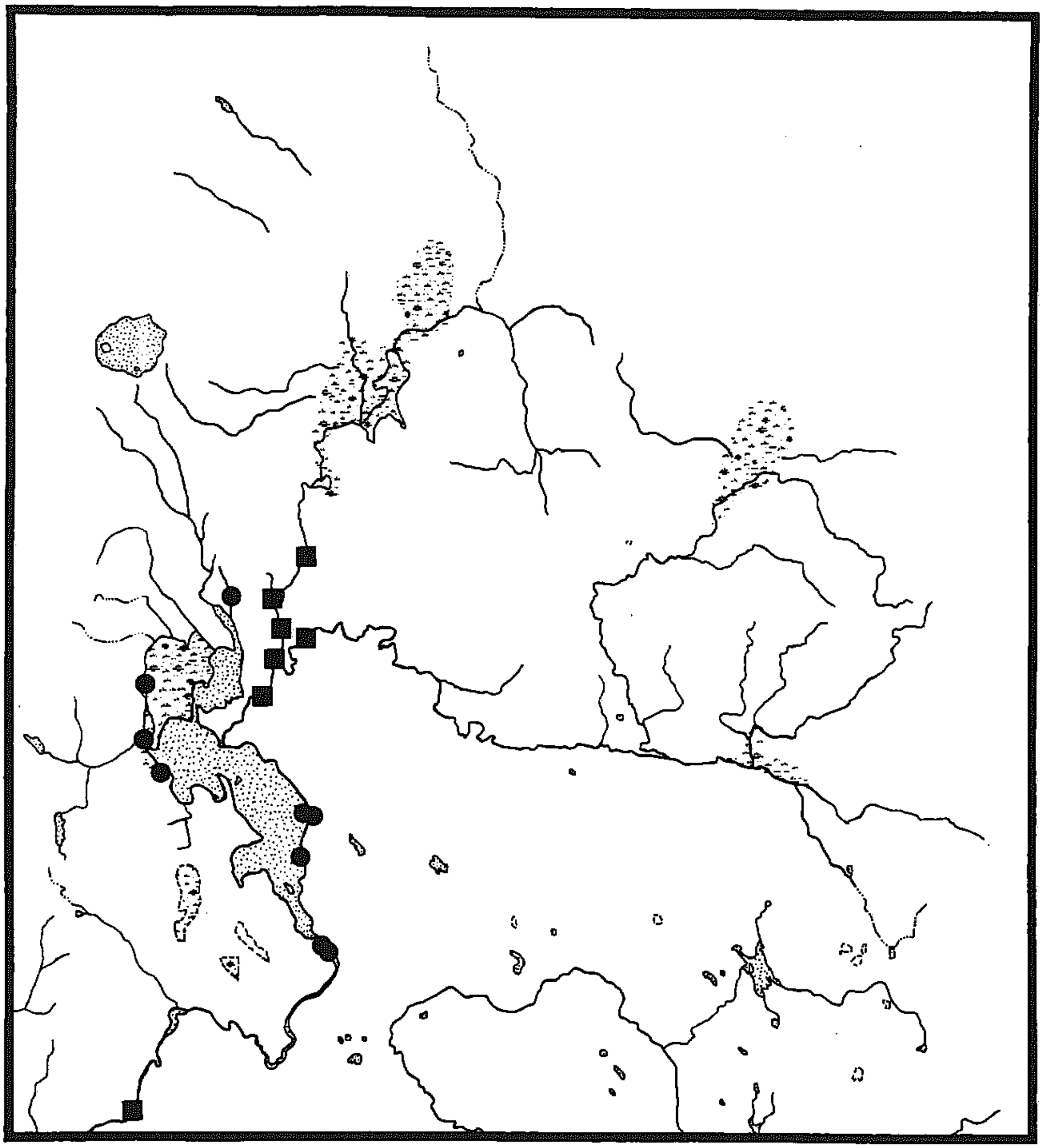


● = *Helisoma (Carinifex) newberryi newberryi* (Lea, 1858)



Juga (Oreobasis) "nigrina" **Frest & Johannes, 1995b**

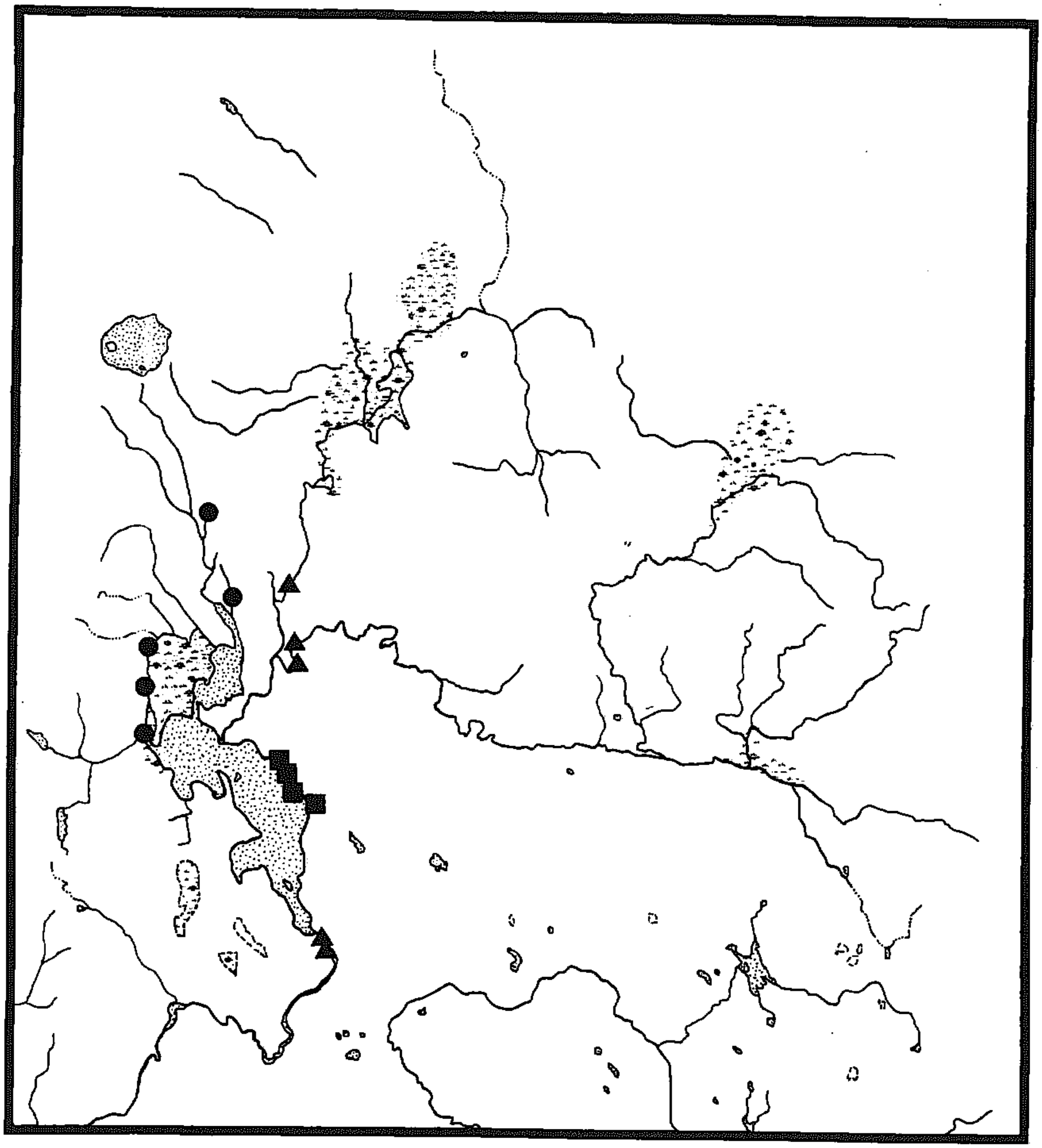
D7



● = *Lanx klamathensis* Hannibal, 1912)

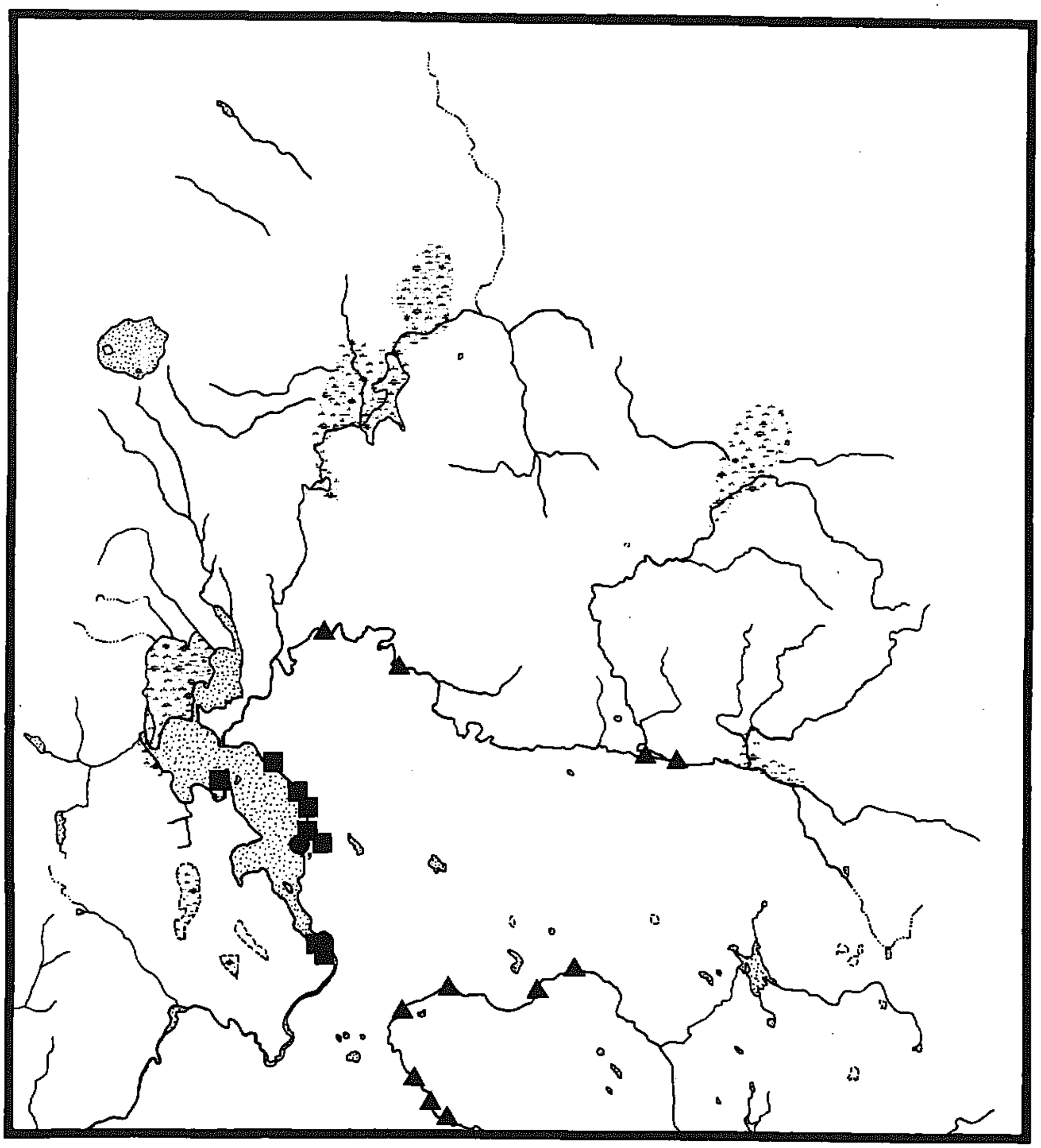
■ = *Lanx alta* (Tryon, 1865)

D 8



▲ = ***Lyogyrus*** **n. sp. 3** ■ = ***Lyogyrus*** **n. sp. 4** ● = ***Lyogyrus*** **n. sp. 5**

D 9

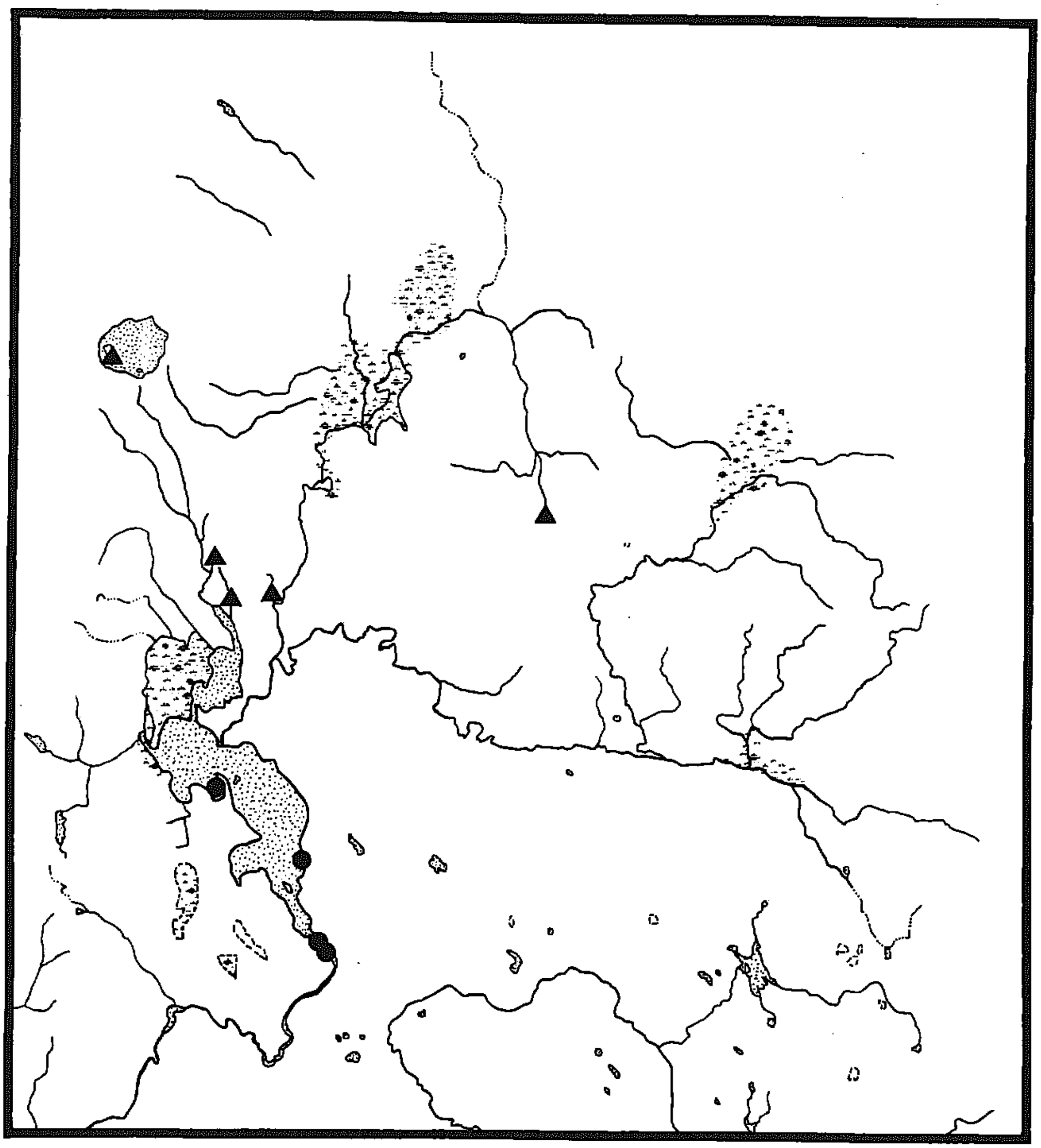


■ = ***Pyrgulopsis archimedis*** **Berry, 1947**

● = ***Pyrgulopsis*** **n. sp. 1**

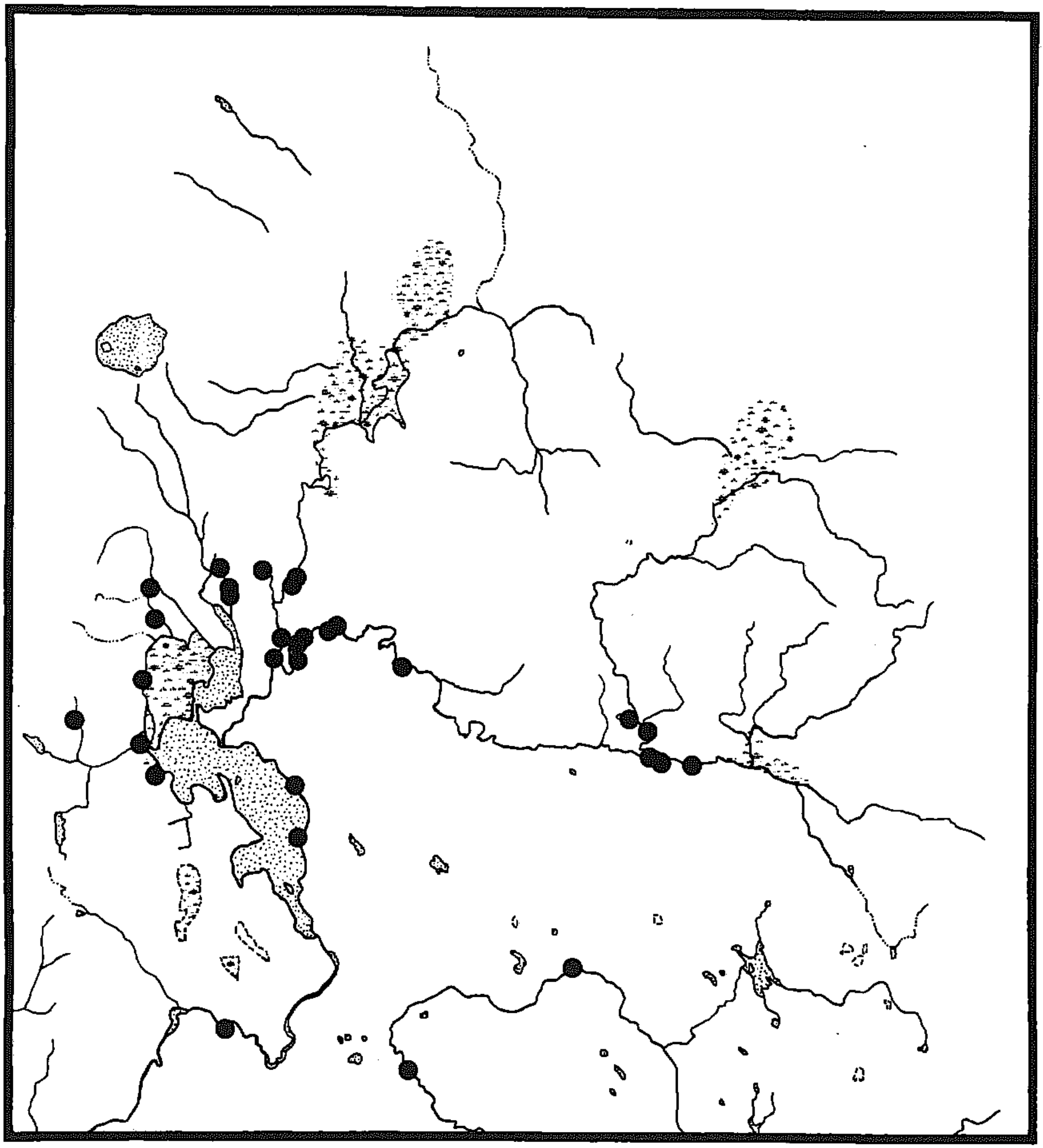
▲ = ***Pyrgulopsis*** **n. sp. 2**

D10

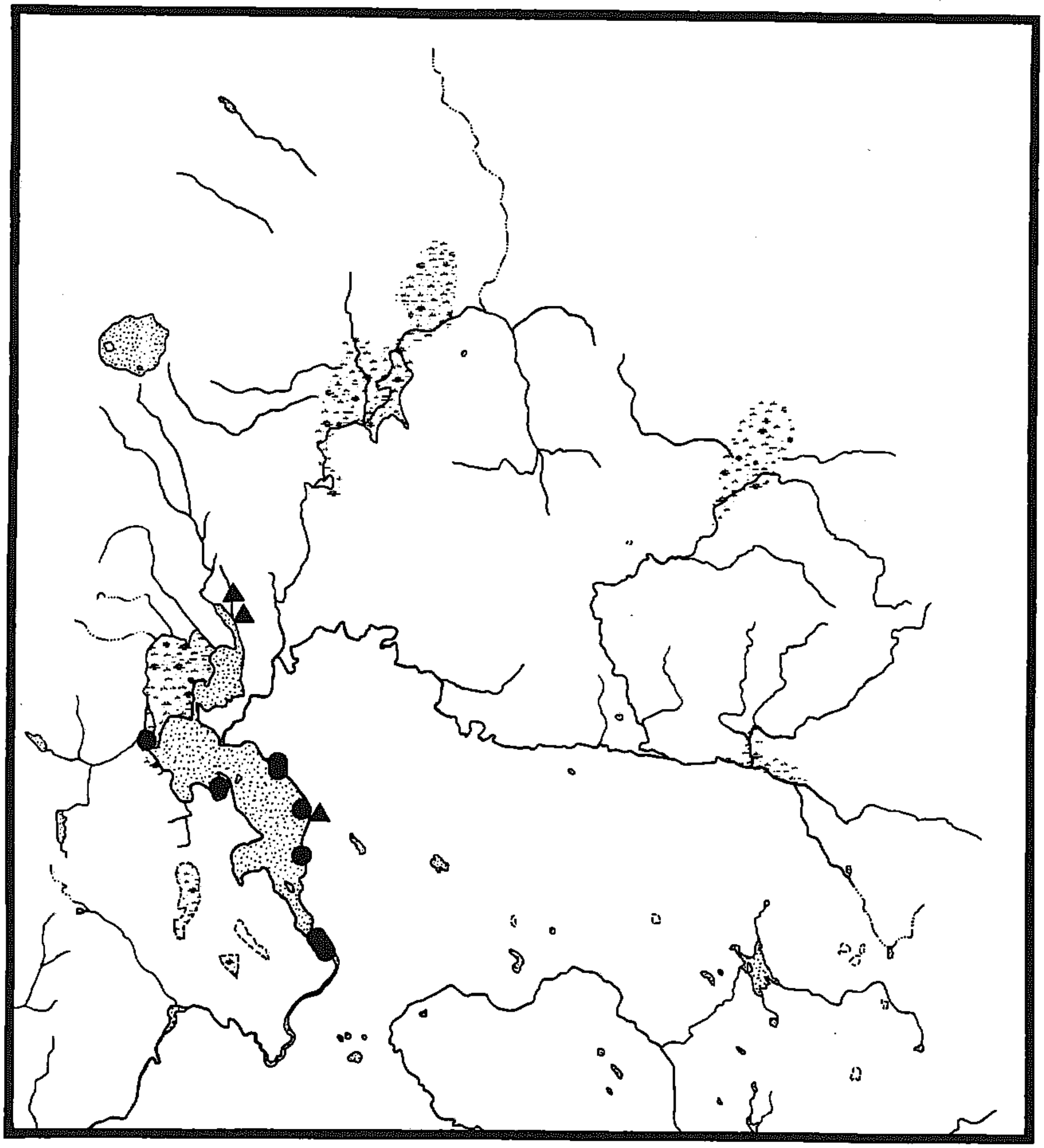


▲ = ***Vorticifex effusus diagonalis*** **(Baker, 1945)**

● = ***Vorticifex effusus dalli*** **(Baker, 1945)**



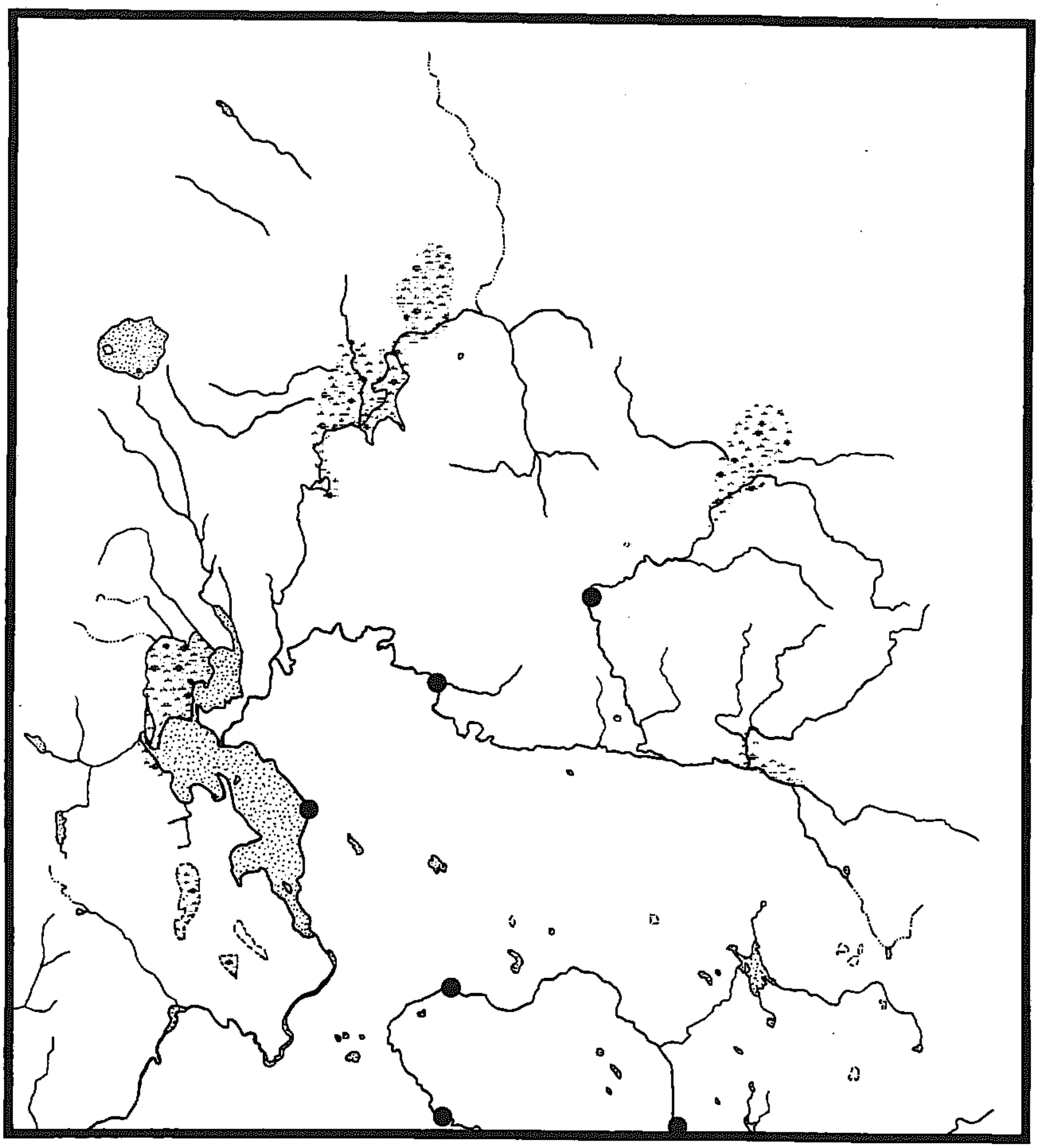
● = ***Vorticifex effusus effusus* (Lea, 1856)**



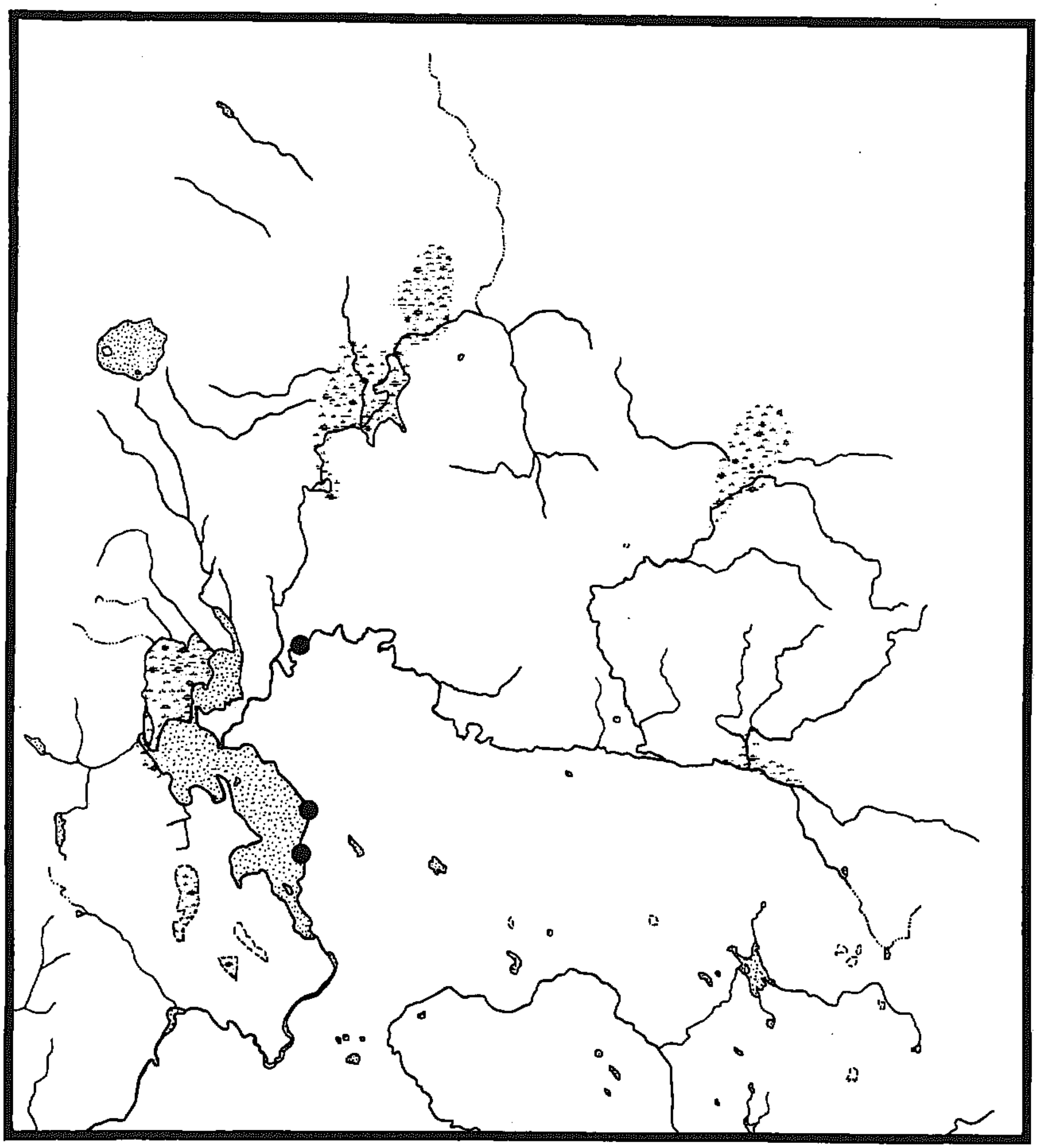
● = ***Vorticifex klamathensis klamathensis*** **(Baker, 1945)**

▲ = ***Vorticifex klamathensis sinitsini*** **(Baker, 1945)**

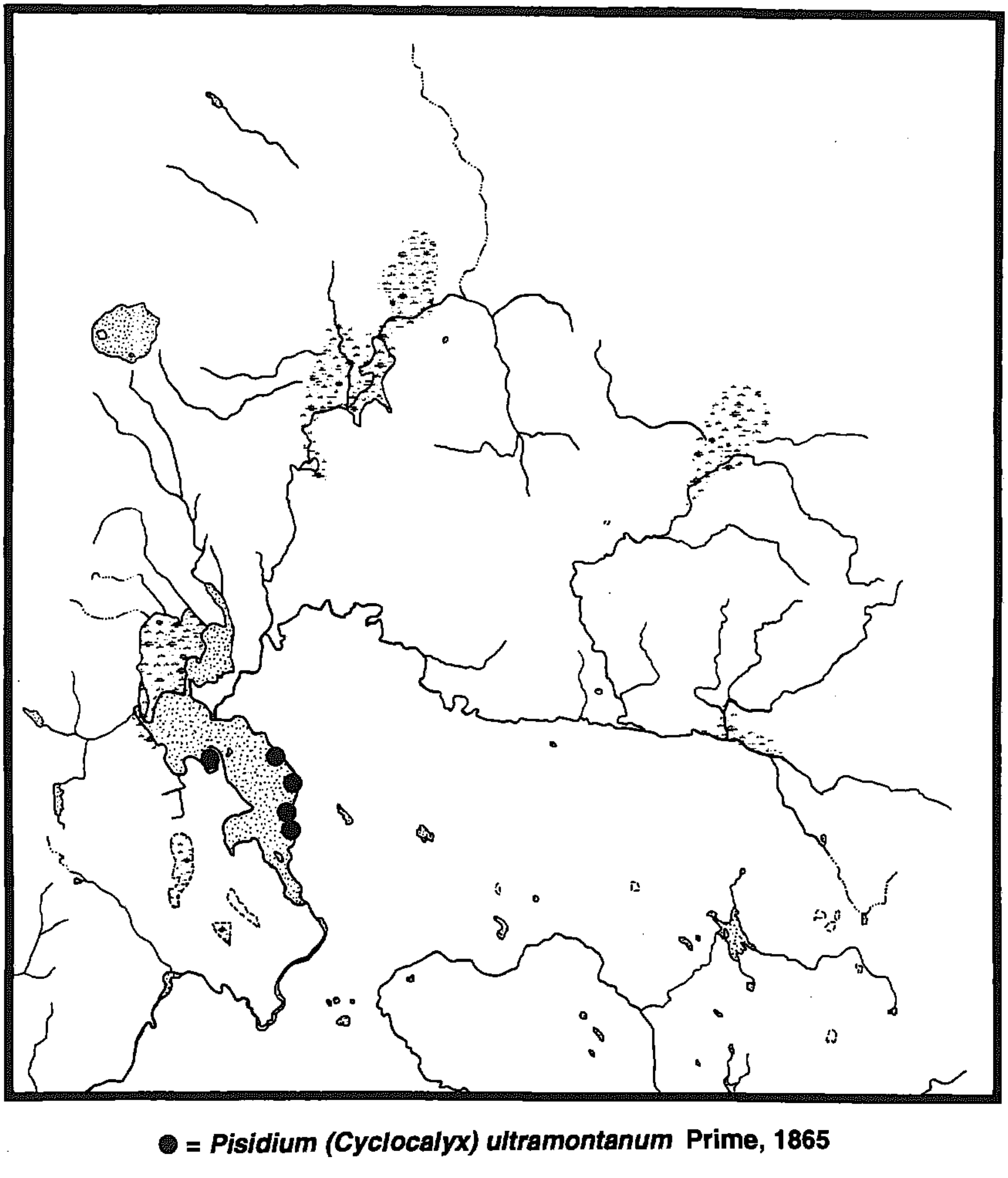
D13



● = *Anodonta oregonensis* Lea, 1838

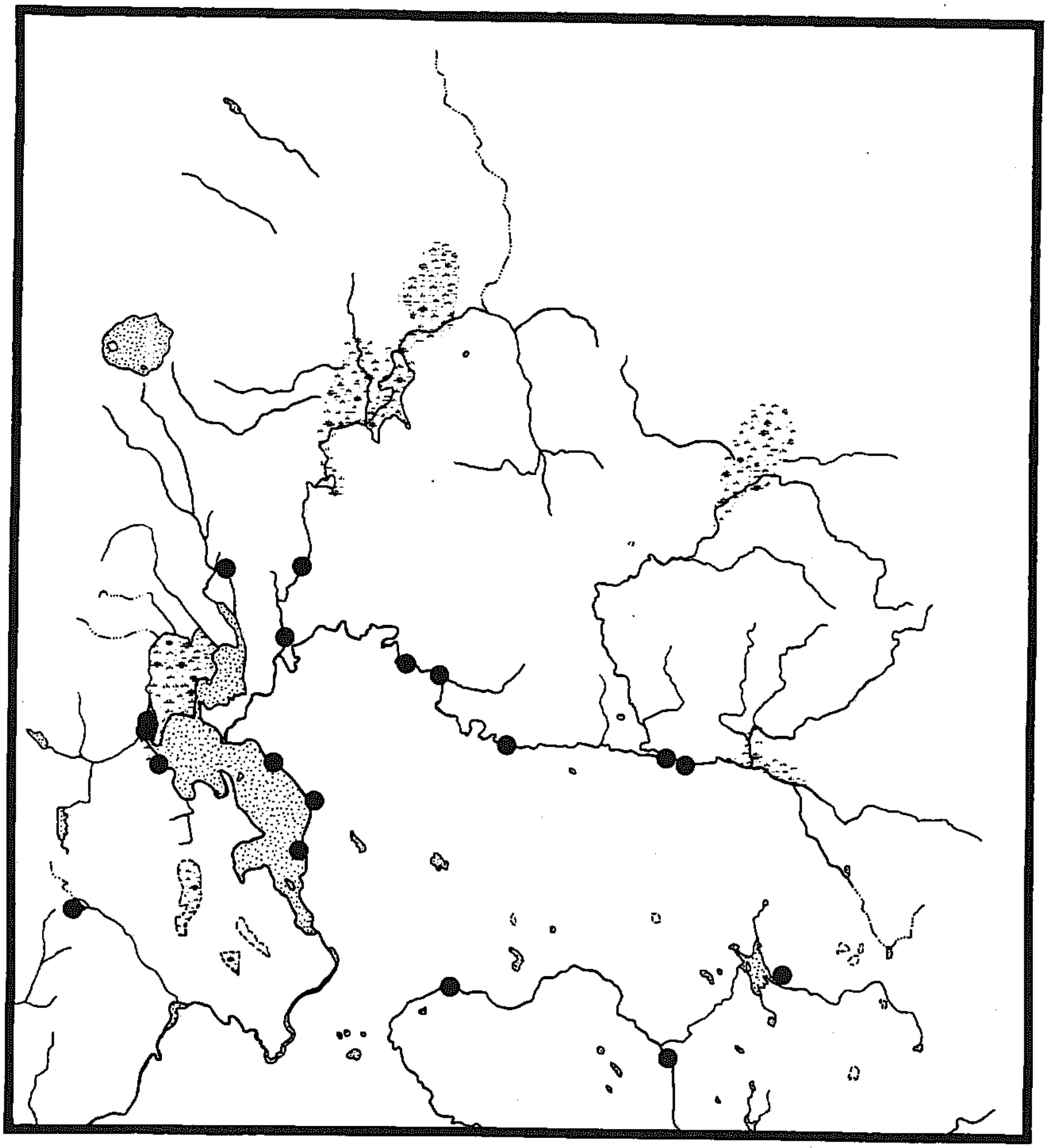


● = *Pisidium (Cyclocalyx)* n. sp. 1



● = ***Pisidium (Cyclocalyx) ultramontanum*** **Prime, 1865**

D16



● = ***Pisidium (Pisidium) idahoense*** **Roper, 1890**

D17